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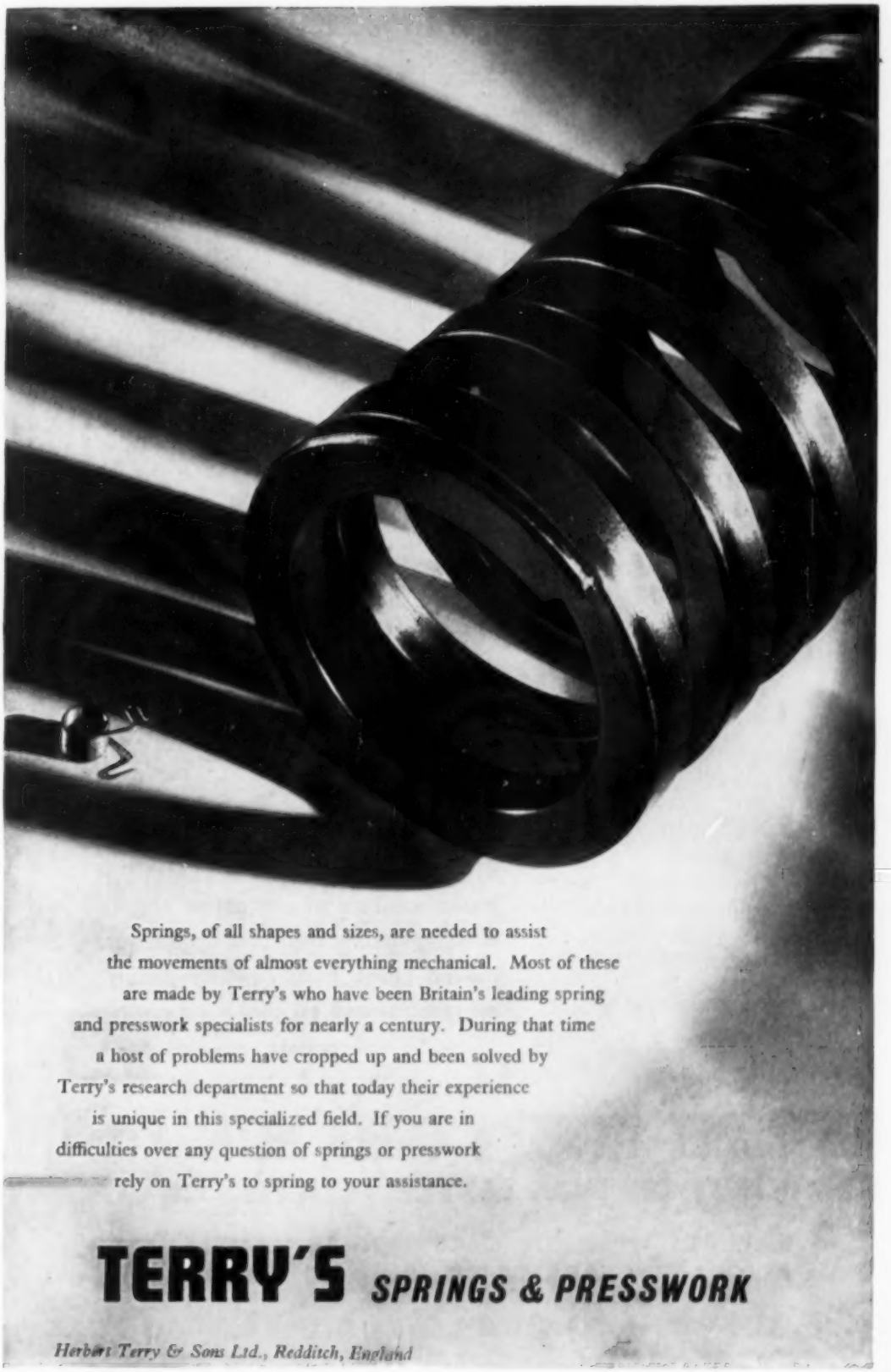
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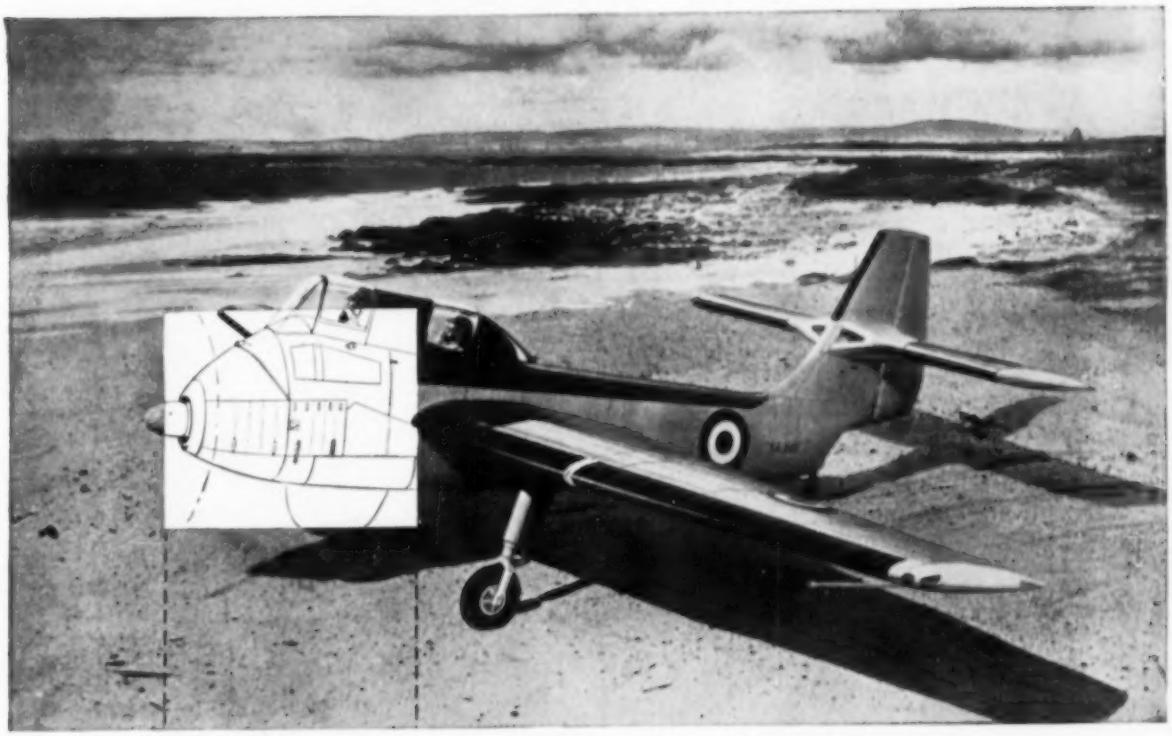

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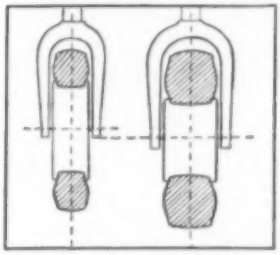

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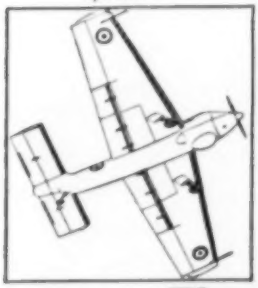

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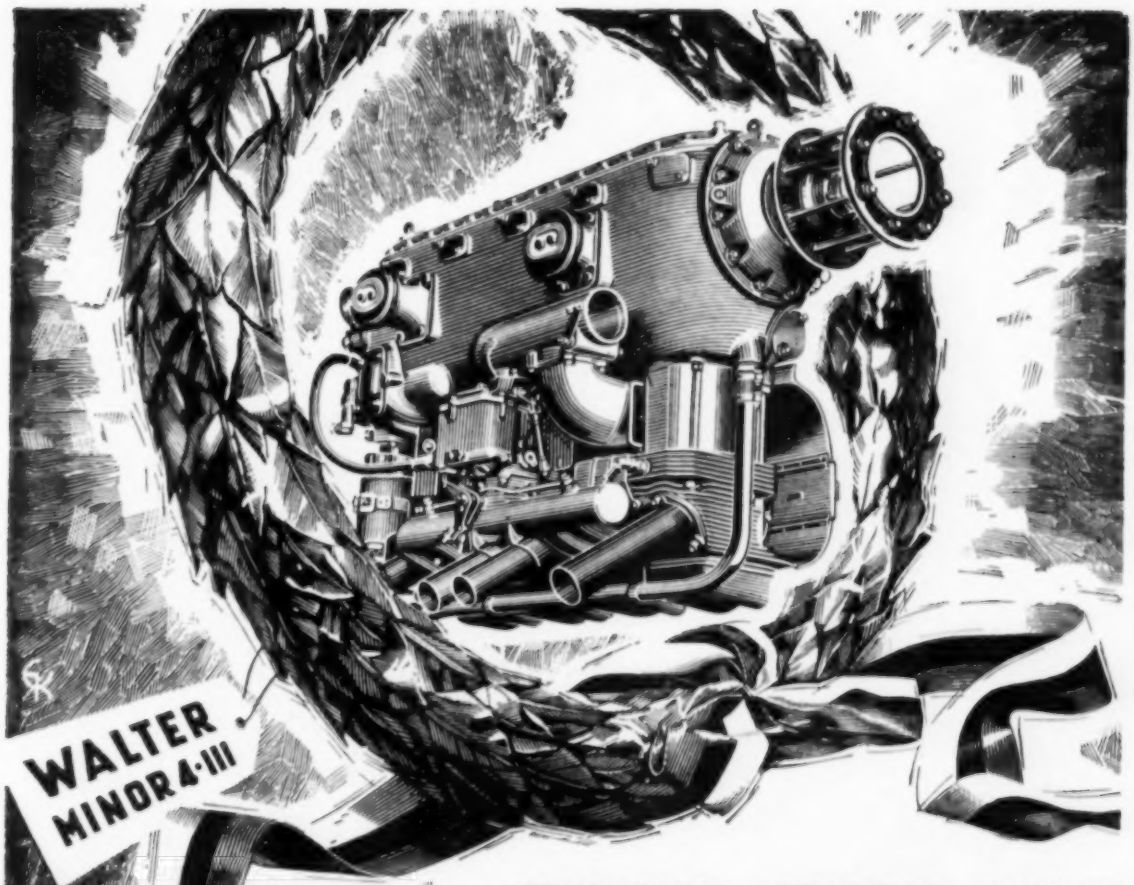

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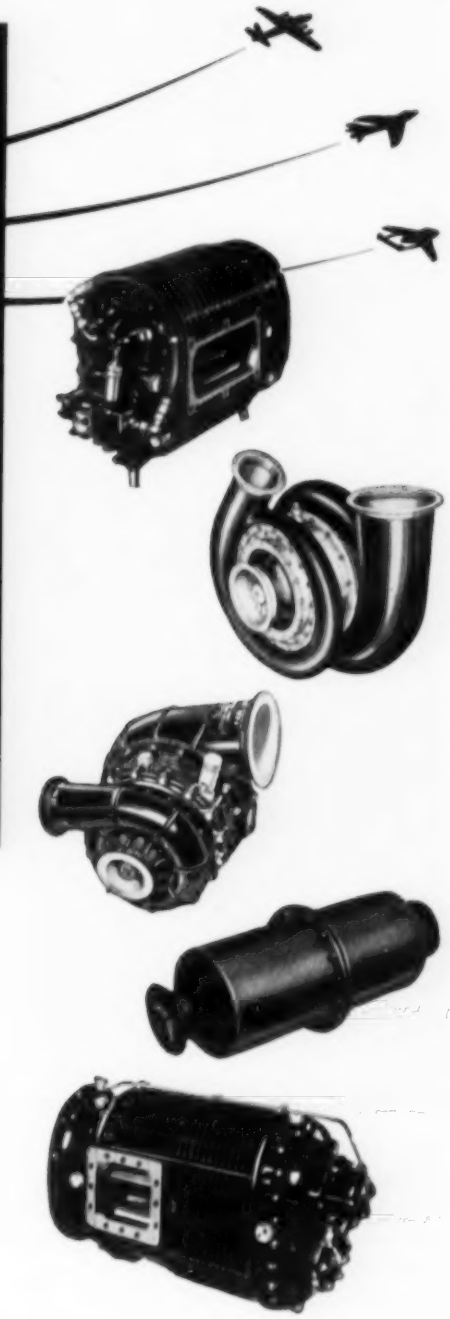

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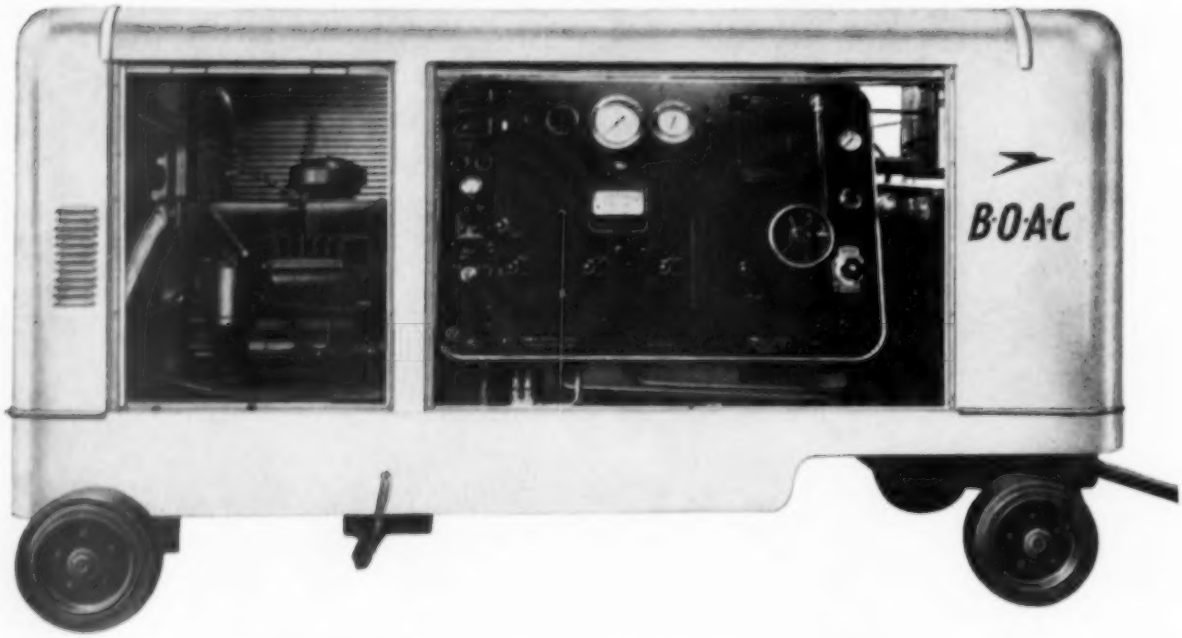

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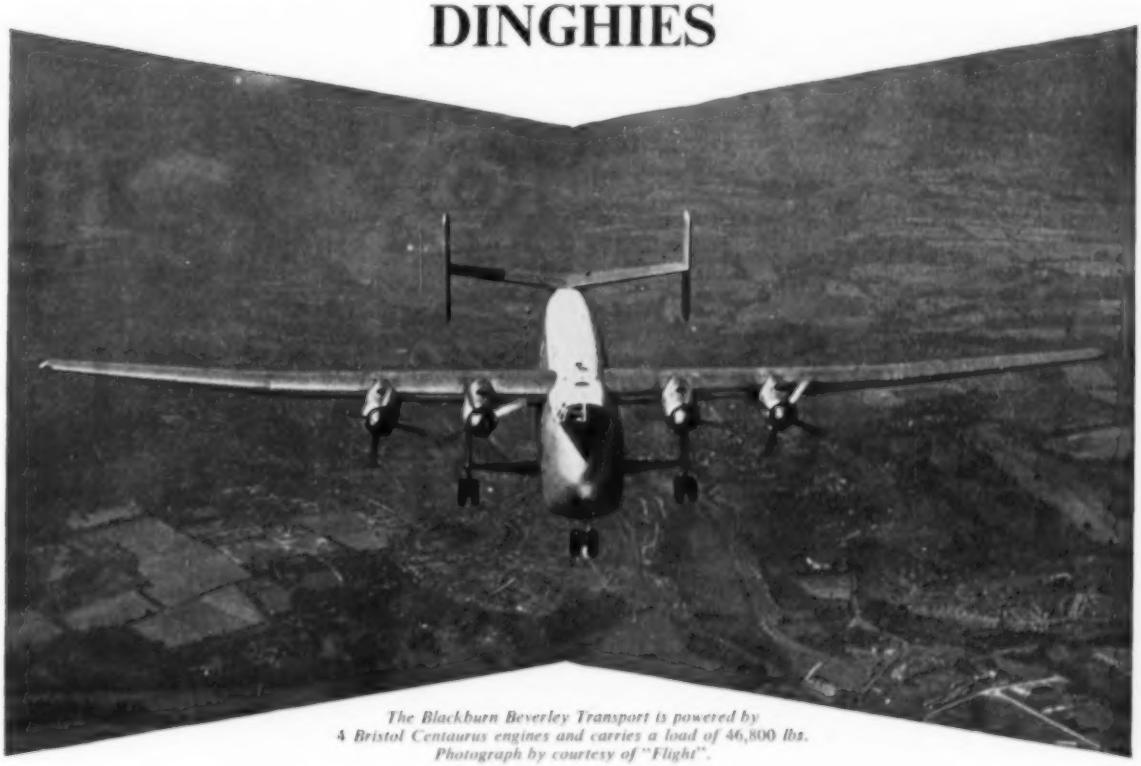

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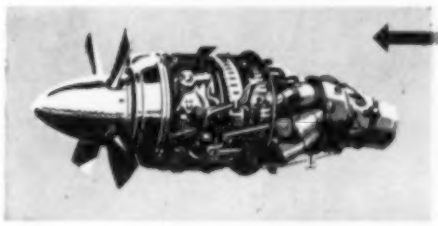

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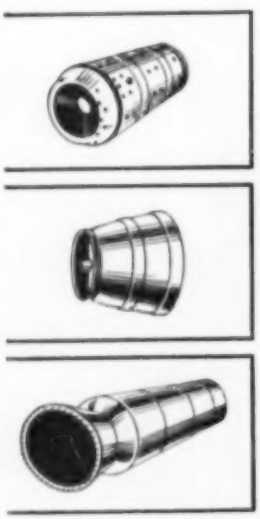

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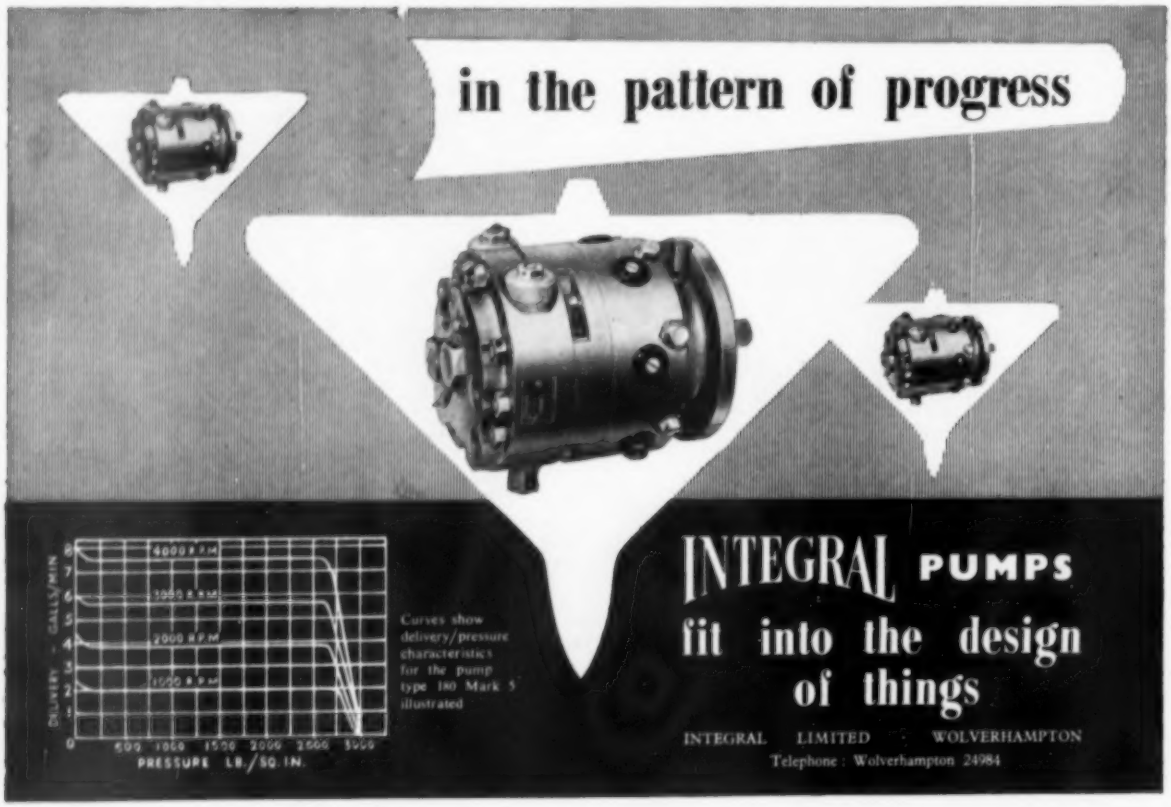
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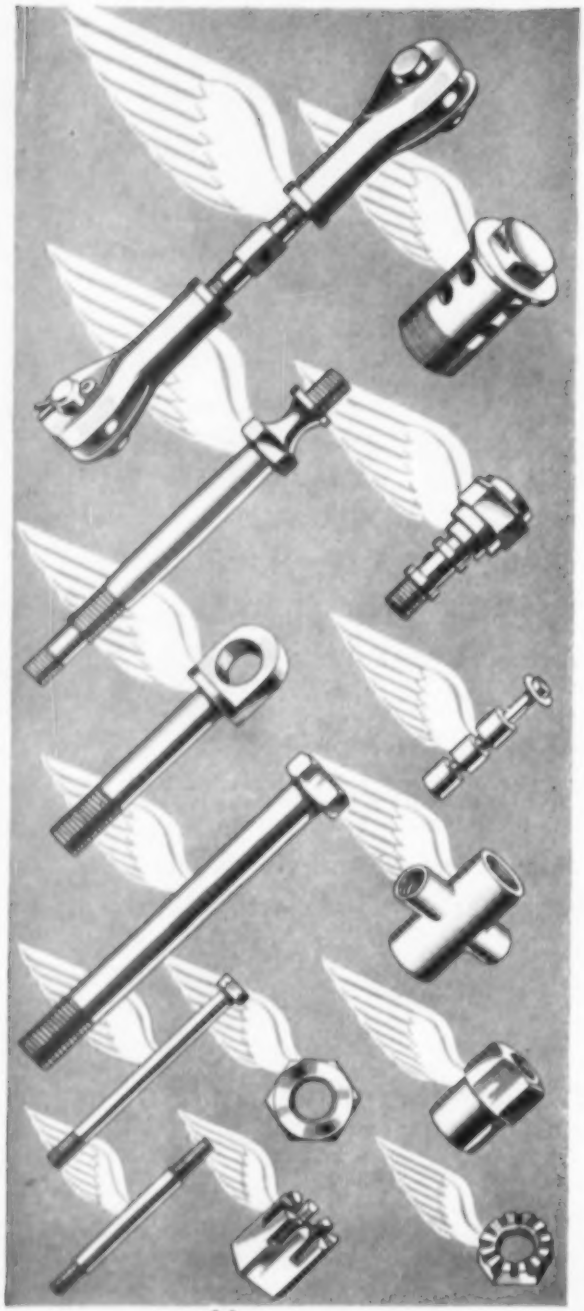

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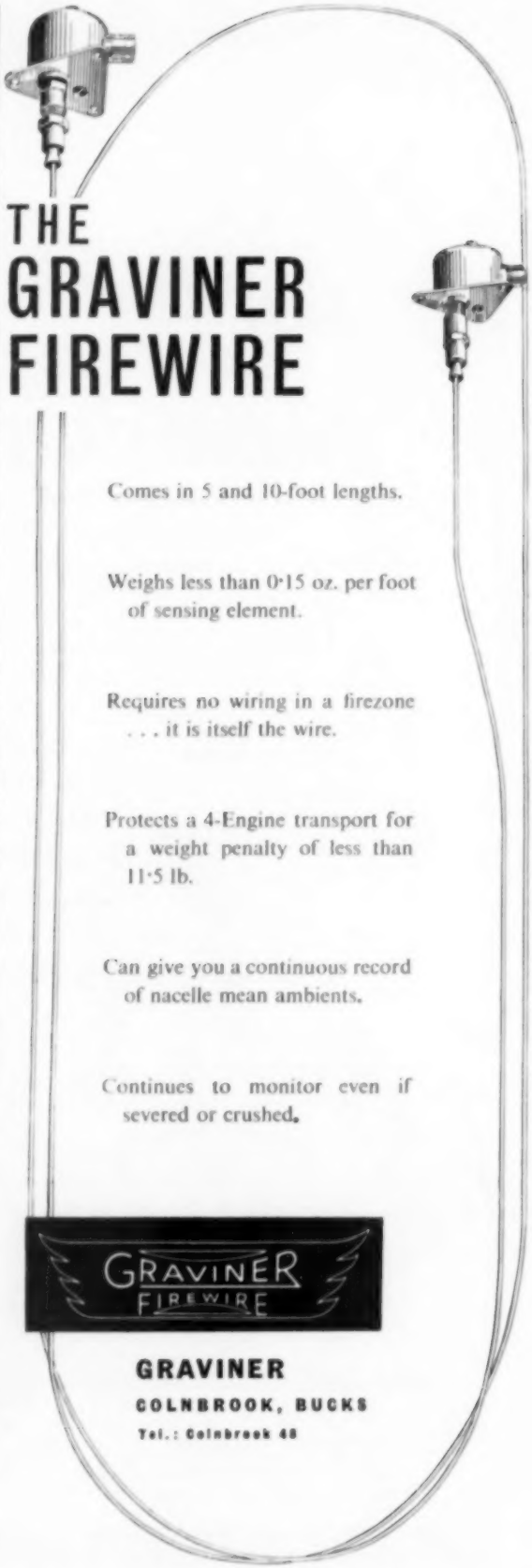

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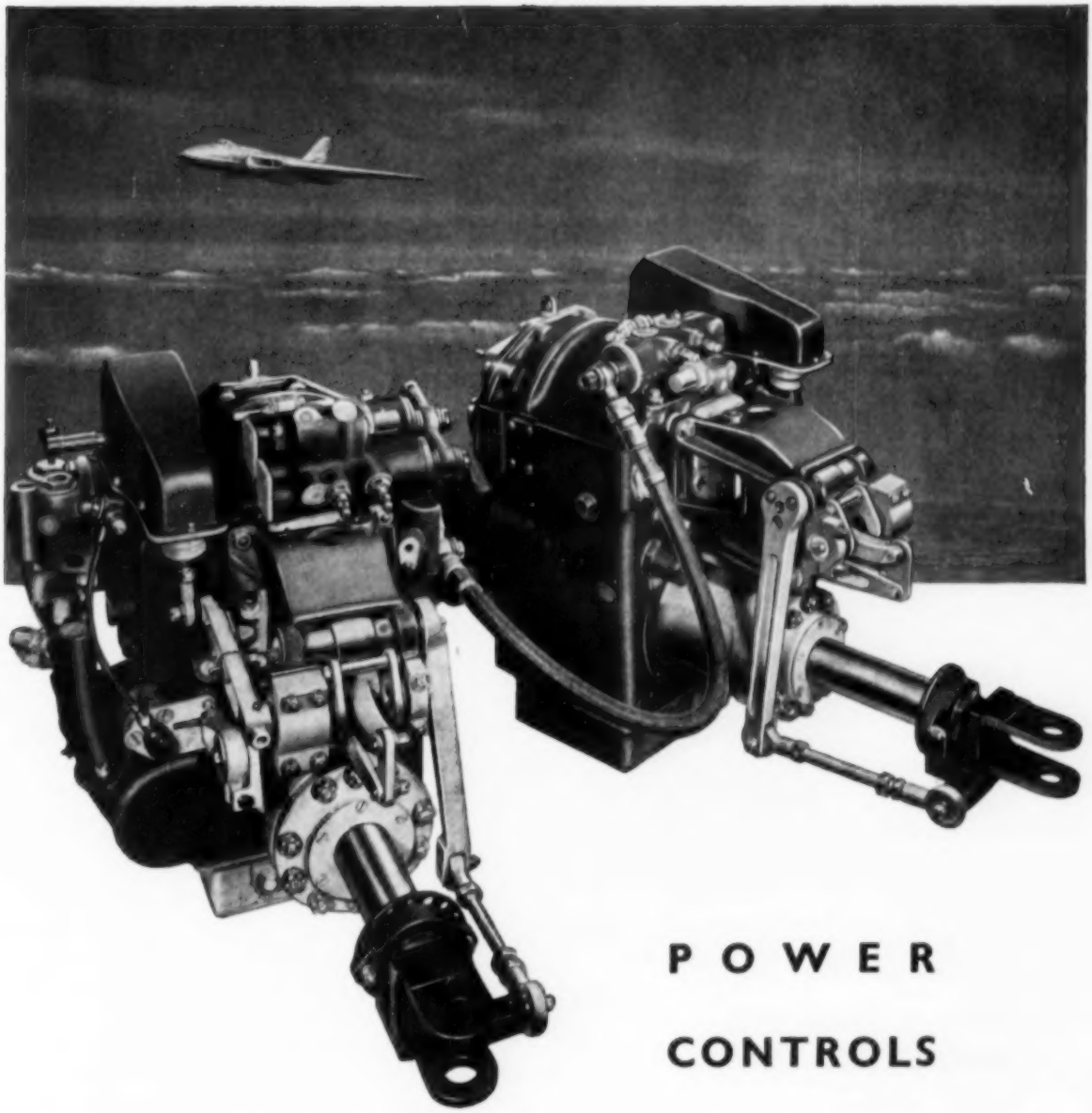

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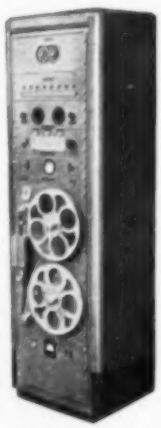

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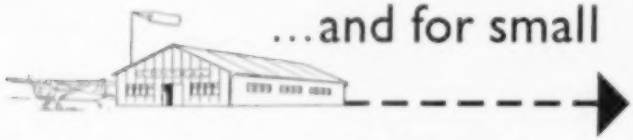

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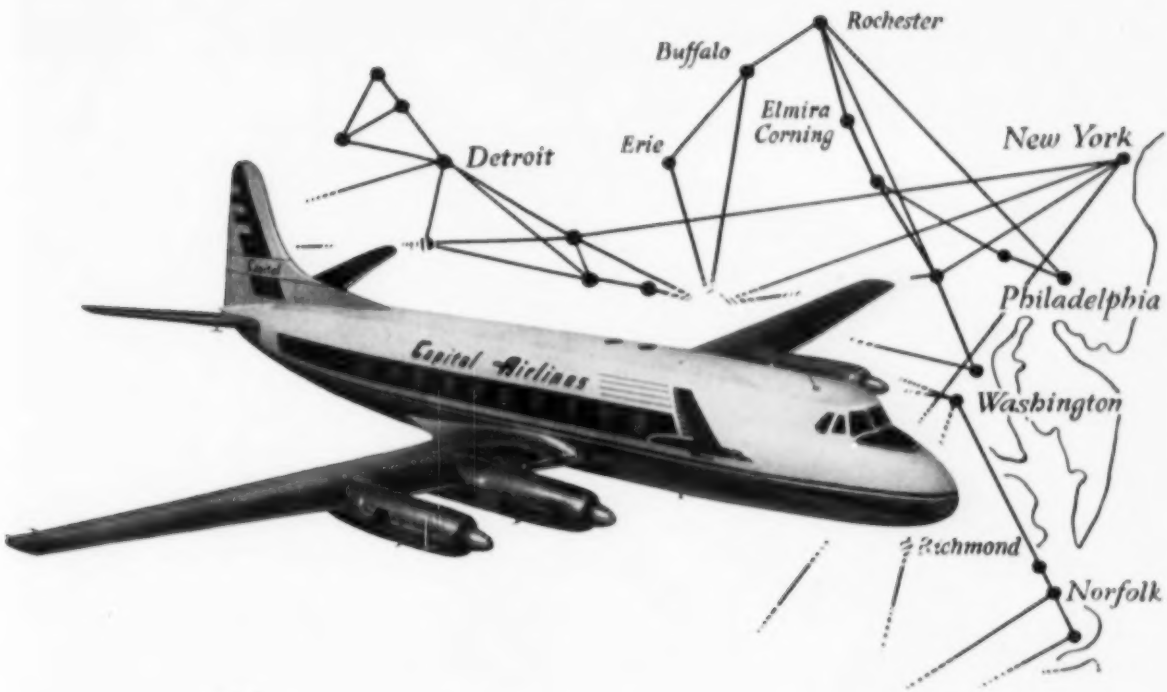

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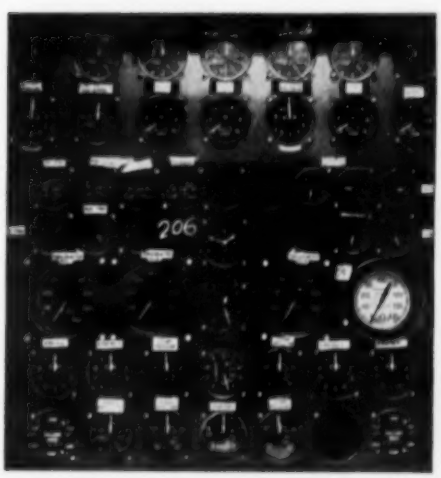

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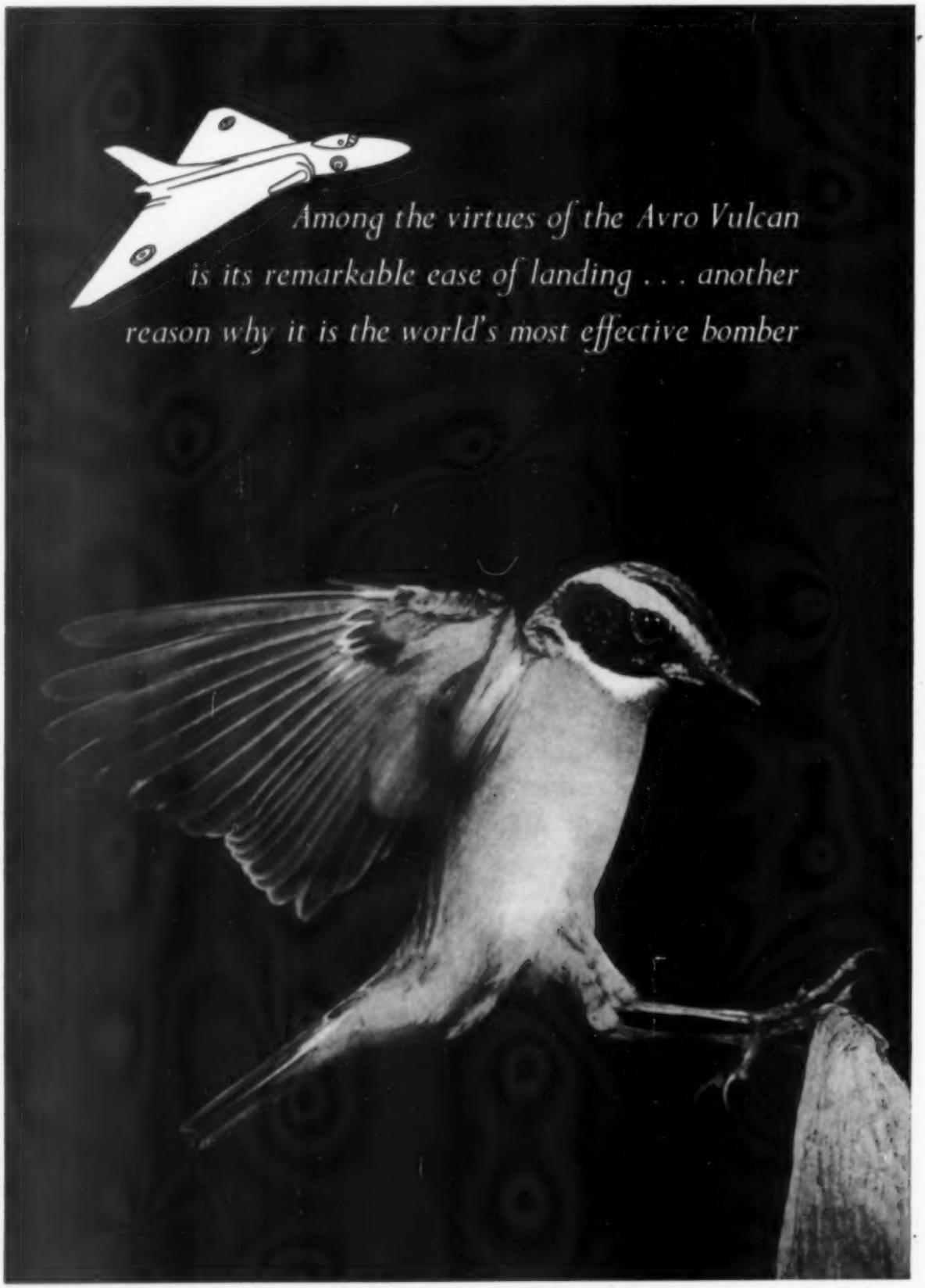
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Cock Wrenlets photographed by Eric Hosking. Taken by high-speed flash with a specially constructed set giving 680 joules with two lamps at an exposure of 1/5,000th second at f/45.

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Expanding Air Commerce

THE air travelling public need have little fear that their hopes and desires are not well understood by the great aircraft manufacturing concerns of the world. That much is at once apparent from the informative personal messages which we are privileged to publish on pages 296-300. Since the operators' bread and butter also depends upon pleasing the customers, it seems that their air travel needs are likely to be well looked after.

Manufacturers apparently agree to a remarkable extent as to the future route and traffic developments. It is over the precise method of carrying the traffic that their views naturally diverge.

Increasingly, references to convenience are creeping into airline and airliner discussions, and rightly so. Not very long ago, the simple establishment of an air link was enough in itself. The attraction of air travel, as represented by convenient times of take-off and landing, and choice of services—after safety, speed and comfort, in that order—is among the most potent of influences in gaining new custom against keen competition from surface carriers. As the airlines win over new adherents, some degree of snowball action can reasonably be expected which will lead to more services and connections and fuller aircraft, to greater flexibility of air travel with less seasonal influence, and only then, in the face of rising costs, to a chance of reduced fares which will enable the cycle to repeat itself.

The influences on air travel which have to be considered include the broadening field of operations. At the lower end of the scale it will not have escaped attention that the promise of helicopters has now compelled their inclusion in all forward planning for local and inter-city services. At the other end of the scale, high-speed long-range services are increasing the scope for world travel. At the moment, the non-stop North Atlantic route and the American coast-to-coast services are the ripe-for-picking airline plums. To the many business travellers on these first-class services, time saved is money saved.

We agree with those who see ample opportunities for both turboprop and pure-jet aircraft to be employed to their particular advantages. The need for both first-class and tourist services was never more apparent. America's pronounced swing-over to turboprops may be regarded as more of a practical expedient than a technical advance. Undoubtedly, too, it has taken place under the influence of the serious but temporary setback of the pioneer Comet 1, and of the enormous cost of designing and developing a completely new jet airliner, as compared with (in the transatlantic idiom) stretching and beefing-up an existing known and de-bugged structure.

By 1965, first-class long-range passenger services will be flown almost exclusively by jet aircraft, but full advantage will have to be taken of their capacity for doing work quickly. It is unlikely that such aircraft will ever have the flexibility of turboprop airliners. Thus, they will still need to be very carefully matched to routes and schedules.

An operator must keep his aircraft earning for as long as possible in each 24-hour period. On some long stages, the positioning problem makes this difficult. A reduction in time for a flight is attractive to the passenger; the operator must think in terms of the number of round trips which can be completed in a given time. From the timing point of view, there are alluring prospects for direct North Atlantic services. A jet schedule convenient for all concerned might be to leave London after breakfast and arrive in New York for lunch, taking advantage of the five-hour time difference. On the return flight, using the same aircraft, take-off might be after dinner at night, with arrival back in London for an early breakfast.

Freight opportunities are only just beginning to be realized, and the amount of cargo carried by air is no more than a fraction of one per cent by weight of the surface total. Experience and publicity are the immediate needs, while the numerous load possibilities are being investigated.

Finally we may express our hope and confidence in the ability of designers to exploit the advantages which aerodynamic developments are now beginning to offer. Greater control of airflow, without doubt, opens a way to more efficient operation and, more important, to safer flying.

FROM ALL QUARTERS

New British Fighters

IT is now officially confirmed that the N.113, to which the First Lord of the Admiralty referred in his Navy Estimates Statement, is a development of the Supermarine 525, powered with two Rolls-Royce Avon turbojets. There is also official confirmation that a new all-weather fighter is being developed from the Gloster Javelin. A Javelin of recent production is depicted opposite.

F-86Ds in England

SECURITY of these islands at night and in bad weather should benefit greatly from the re-equipment of the U.S.A.F.'s 406th Fighter Wing with North American F-86D Sabres. The Wing, which comes under the direct operational control of Fighter Command, has two squadrons at Manston, Kent, and a third at Bentwaters, Suffolk.

The F-86D is a single-seat all-weather fighter, armed with 24 automatically aimed and triggered 2.75in folding-fin rockets, stowed in a retractable magazine.

Gnat and Midge

UNLIKE the gnats in Keats' ode *To Autumn*, the light fighters of the name under construction by, or in contemplation by, Folland Aircraft, Ltd., are far from being a "wailful choir." Good news comes in on several aspects of development, and from India it is learned that the Indian Government is negotiating with the Bristol Aeroplane Company for the manufacture of the Orpheus turbojet, should it be decided to re-equip I.A.F. units with Gnats. A.Cdre. F. R. Banks is taking part in the deliberations on behalf of the Bristol company, and there is a distinct probability that permission will be sought to build the Gnat in the factory of Hindustan Aircraft, Ltd.

Meanwhile, the Midge (low-powered prototype of the Gnat) has completed 65 hours of test and demonstration flying, has been flown by 14 different pilots, and is now being fitted with a wing "having technical features similar to those of the Gnat." Flight trials will probably be resumed early next month. The first Gnat should fly in the summer of this year, and the second in the autumn. It is known that a thinner wing for the Gnat has been studied, and that on the first prototypes the span will be increased to 22ft 2in, the corresponding measurement of the Midge being 20ft 8in. Large-area inboard ailerons are being fitted and are expected to give a rate of roll of at least 200 deg/sec over a wide range of speed and height, without imposing undue twisting forces on the wing. Design studies are said to have shown that the Gnat could be developed into an all-weather fighter, and eventually into a fighter "meeting the most stringent terms of all-weather day-and-night-fighter specifications."

Flight tests of the Midge to date have covered low-speed handling and stalling; measurement of stick force per g; lateral and directional stability; longitudinal stability; high Mach number effects; and measured landings. The stall begins at about 105 kt true, but is not fully developed until the control column is right back. Nor, it is said, is there any tendency towards instability at any stage of the stall. No buffeting occurs up to speeds in excess of Mach 1, but more work has yet to be done in analysing trim changes at high speed. Experience has shown that such trim changes as do occur can be held single-handed. Without the use of the braking parachute the normal landing run is 750-1,000 yd; but, with the parachute and standard brakes, runs as short as 450 yd have been achieved in still air. More tests have yet to be undertaken to determine the best landing technique.

In the matter of armament, it is learned that, although in the present Gnat installation the empty shell cases from the two Aden guns are ejected and the links collected, experiments are in progress which may lead to the ejection of the links also.

B.O.A.C.—Problems, but a Profit

LAST week, Sir Miles Thomas, while in flight over the Atlantic, dictated a "State of the Union" message to all B.O.A.C. staff. He said: "The task of administering our Corporation during the last twelve months has been extremely difficult. The grounding of the Comets completely unravelled our route pattern and, by depriving us at one fell swoop of 25 per cent of our capacity, not only called for much ingenuity and effort to keep our traffic flow anything like effective in the face of growing competition, but naturally had an extremely adverse effect on our ability to make a profit. . . .

"Apart from the disruption to the fleet, there was the change from Filton to London Airport, the part-occupation of the new big hangars, and the multiplicity of crew-training problems as well as physical engineering tasks that the acquisition of replacement Constellations and Stratocruisers imposed.

"At this moment we have less than a month of our current financial year to run, and . . . unless some completely unforeseen disruption occurs we shall again show both a gross profit and a net surplus this year. They will not be as much as last year's and will be nothing like as much as we had expected to achieve had the Comets not been grounded. . . .

"The flying staffs of the Constellation 049s on the Atlantic have had a particularly difficult task building up tourist business in the face of competition coming from other operators using new Super-Constellations and Douglas DC-6s.

"During February our future became greatly clarified. The two major decisions—for the Comet to come back again and for us to be allowed to acquire ten Douglas Seven Seas—give us a firmer basis for planning. Unfortunately, the dates for the reintroduction of the Comet, and for that matter the introduction of the Britannia, are by no means firm. I would like to see more hours being piled up by Britannias on flight test than have so far been achieved, but our crews who are flying them report favourably on the handling characteristics of the aircraft. . . .

Sir Miles then mentioned temporary arrangements for chartering other aircraft, such as the Seaboard and Western Constellations. He continued: "It is a pity that we have to do this even on a temporary short-term basis. While we undoubtedly believe

IN HAND AT READING: Good progress is being made with the first prototype of the H.P.R.3 Herald; the fuselage is seen here. The machine is expected to fly in time for Farnborough. In the meantime Alvis Leonides Major power units will be building up hours in H.P.R.5 test-bed, left.

***OFF THE LINE:** Subject of this topical Russell Adams picture is Gloster Javelin F.A.W.1, service number XA 550; the pilot, S/L. Peter Scott. First production Javelin, at Farnborough last year, was XA 544.*

that the Britannias will ultimately be a fine aircraft, yet we cannot maintain a hold on expanding business on a 'jam tomorrow' basis and must have access to aircraft that can currently carry the traffic." He added that there was also the necessity for getting the converted Stratocruisers and Constellations into operation, and for making arrangements for the introduction of the Douglas Seven Seas.

The message concluded with references to the Corporation's cabin service —"one of the B.O.A.C.'s greatest assets."

Herald Progress

WITH the minimum of fanfares or fuss, Handley Page (Reading) have been pressing on with the building of the two prototypes of their Herald feeder-liner, which precede what is already to be a substantial production batch. Orders have been placed by Australian National Airways and Queensland Airlines, and last week a third company, Lloyd Aero Colombiano, who are based at Bogota in Colombia, became the third company to sign a contract for Heralds. This brings the total of orders to 29 and deliveries are scheduled to begin in 1957.

Appropriately, such adjectives as "workaday," "robust" and "versatile" are being used in connection with the four-engined Herald. It is intended to operate from small airfields with the minimum of servicing equipment. In its pressurized fuselage —the first is illustrated on the opposite page—some 44 passengers can be accommodated, and carried over short or medium stages at a cruising speed of 200 plus m.p.h.

The Alvis Leonides Major 870 h.p. piston engines are about to start their air tests in the H.P.R.5 Marathon test-bed, which is expected to fly this week from Reading, with S/L. Hazelden at the controls. After preliminary trials, it will be taken over by the engine manufacturers to continue with engine testing and development work.

Airfield Customs Wanted

THE lack of "on call" Customs facilities at certain non-State-owned airfields was brought to the attention of the Minister of Civil Aviation last Friday by a deputation representing airport owners and others interested.

At a 90-minute meeting, it was suggested to Mr. Boyd-Carpenter that the lack of facilities was causing operators expense and inconvenience and hampering the growth of traffic. The Minister undertook to consider the representations and to look into some specific cases, details of which the deputation promised to forward to him.

Members of the deputation were Cllr. L. W. Biggs (chairman of Manchester Airport Committee) and Mr. C. M. Newton (of Sywell Aerodrome), representing the Aerodrome Owners' Association; Mr. R. V. Perfect, for the Air League; and Ald. Rhodes Marshall (Blackpool) and Cllr. T. Earnshaw (Derby), for the Association of Municipal Corporations.

Tye on Fatigue

THE second Barnwell Memorial Lecture, held at Bristol last Tuesday, was the occasion of a paper, *The Outlook on Airframe Fatigue*, by Mr. Walter Tye, O.B.E., B.Sc., F.R.Ae.S., chief technical officer of the Air Registration Board. After an historical introduction to the subject, Mr. Tye dealt in turn with the safe life of spars, wing tests, pressure-cabin testing, the present situation, the immediate future and longer-term developments.

The lecturer concluded that, although full-scale and *ad hoc* fatigue-testing was necessary for the immediate future, in order to "reach a position where a safe life is really safe," the ultimate solution, in his belief, was to obtain sufficient understanding to design structures, the fatigue failure of which would be well beyond the operational life and in which, if cracks did occur, the failure would be non-catastrophic.

Naval Aircraft Debated

IN his statement to the House of Commons on the Navy Estimates, Mr. J. P. L. Thomas, First Lord of the Admiralty, said that by the end of the year the front-line Fleet Air Arm would be completely equipped with jet and turboprop aircraft in the day and all-weather fighter and strike and anti-submarine rôles.

New aircraft were planned to replace all those in the Fleet Air Arm which had been in front-line service this year, and substantial orders had been placed for a new single-seater day fighter —the N113—which would replace the Sea Hawk and had been designed to carry guided missiles (see first news paragraph).

The D.H.110, replacement for the Sea Venom, was described by Mr. Thomas as a first-class aircraft for naval purposes. It had been subjected to intensive tests since the accident at Farnborough in 1952, and it should enter service with far fewer latent troubles than other aircraft. It was designed to carry a guided missile.

After references to the Gannet and the Whirlwind helicopter, he went on to say that the conversion of most of the R.N.V.R. fighter squadrons to jets was planned to take place this year, and within the next year or two they expected to give the R.N.V.R. air divisions Sea Hawks, Gannets and Seamews. At the same time the R.N.V.R. establishment of these costly aircraft would have to be reduced by about one-fifth and there would also have to be some reduction in aircrew.

In a defence of the aircraft carrier, Mr. Thomas said that this type of vessel had proved its value for all to witness in the Korean war. The expert advice given to the American Navy and to our own supported the carrier battle group full out in a war of nuclear weapons as a self-protecting, largely self-contained mobile airfield. Such a battle group, as described in the White Paper, was compact and hard-hitting and at the same time flexible and elusive. In the last war much was said of the vulnerability of the carrier, but of the 226 carriers used by all sides, only 39 were sunk and of these only four by shore-based aircraft. Of these four carriers, which were all American, three were sunk by Japanese suicide aircraft. As for a future war, the carrier battle group as a mobile target with its screen of fighters and its early warning aircraft might well be relatively immune from some of the most formidable of modern weapons.

In the section of his speech devoted to guided-weapon progress, Mr. Thomas said that ship-to-air missiles would be tested at sea next year in the experimental guided-weapon ship *Girdleness*.

In the debate which followed, Mr. James Callaghan criticized current aircraft equipment in the carriers. Neither the Sea Hawk nor the Attacker, he maintained, was capable of overtaking and intercepting the aircraft it would have to meet. He also spoke of "severe strictures" on the D.H.110 made by another Member.

Several Members made references to the merits or otherwise of a suggested integration of the R.A.F. and the Navy. Supporting the suggestion, Capt. Robert Ryder said that an examination should be made to see if some kind of fusion could be achieved. Nobody suggested that that was going to be done suddenly or would even necessarily be a complete fusion.

What was going to happen in the case of the ship-to-air guided missiles? After all, some of the problems of the identification of distant aircraft were much the same. "Are we," asked Capt. Ryder, "to have the Royal Air Force mounting these new 'guns' of the Fleet, or are we going to have guided missiles at sea under the control of the Navy and so work contrary to the decision made on land?"

Air Safety Board Appointment

FOR the first time in six years, the Air Safety Board has announced a change in its membership. This follows the acceptance by Sir William Scott Farren of an invitation from the Minister of Transport and Civil Aviation to join the Board in place of A. Cdre. F. R. Banks, who recently resigned. Sir William Farren is technical director of A. V. Roe and Company. He was previous president of the Royal Aeronautical Society (1953-54) and one of the three assessors at the Comet Inquiry.

It may be recalled that the Air Safety Board, set up by the Minister of Civil Aviation in 1946, has as its terms of reference: "to keep under continuous review the needs of air safety in British civil aviation and recommend measures likely to promote safety in respect of both the operation of British civil aircraft throughout the world, and the efficiency of the ground facilities provided for civil

FROM ALL QUARTERS . . .

aircraft of all nations operating over the United Kingdom."

The Board's composition is now: Air Chief Marshal Sir Frederick Bowhill, G.B.E., K.C.B., C.M.G., D.S.O. (chairman); Lord Brabazon of Tara, G.B.E., M.C., P.C., F.R.Ae.S.; Sir Leonard Bairstow, C.B.E., F.R.S., D.Sc., F.R.Ae.S.; Sir Arnold A. Hall, F.R.S., M.A., F.R.Ae.S.; Sir William S. Farren, C.B., M.B.E., M.A., F.R.S., M.I.Mech.E., F.R.Ae.S.

Captain R. T. Shepherd, O.B.E.

ALL who have known him over a long period of years in aviation will have learned with deep regret of the death of Capt. R. T. Shepherd, who had been chief test pilot to Rolls-Royce, Ltd., for 16 years. He died at his home at Nuthall, Nottinghamshire, on March 1st, after a short illness. He was 58 years of age.

"Shep"

"Shep's" career began with Vickers-Armstrongs in the gun manufacturing industry, and on the outbreak of the 1914-18 war he joined the Honourable Artillery Company, transferring to the R.F.C. in 1916. Among the squadrons with which he served were No. 102 (F.E.2bs) and No. 37 (Camels), and he flew on night operations against Zeppelins. He left the Service in 1918 but rejoined it in 1921, serving in England and in Egypt until 1929, when he was placed on the Reserve. Thereafter, he was C.F.I. to Phillips and Powis, Reading, and was subsequently with National Flying Services and managed the Nottingham Flying Club.

In October 1931, Capt. Shepherd made his first flight for Rolls-Royce, testing a Fairey IIIF with a Kestrel engine. During the next three years he flew regularly for the company, and when they started their own flight establishment at Hucknall in 1934, Shepherd was appointed chief test pilot, a post which he held continuously until 1951. During the post-war years he was, of course, mainly concerned with gas-turbine flying. He was the first man to fly on Nene and Avon engines—in the Lancastrian flying test-bed; he flew this aircraft at the 1946 S.B.A.C. Show. In 1951—in which year he had a serious illness and two major operations—he relinquished full-time test flying and was appointed flying consultant to the Rolls-Royce management.

The old urge remained, however, and when the most unconventional aircraft ever produced—the Rolls-Royce "Flying Bedstead"—was ready for testing, he made a special request that he should be allowed to conduct the initial work. "Shep" made the first flight on August 3rd last year.

In 35 years of flying, he handled 77 different types of aircraft and logged over 8,000 hours. Official appreciation of his outstanding work as a test pilot, and in particular of his flight-development work on the Merlin engine, came in 1946, when he was appointed O.B.E.

Helicopters in Commercial Use

ALTHOUGH, in their present state of development, helicopters cannot properly be classed as transports and assessed alongside fixed-wing airliners, the fact remains that a great deal of valuable work is being done by rotary-wing machines. In order that the characteristics of some of the more important helicopters should have a place in this special air-transport issue we have prepared the table at the foot of col. 1; it includes typical data for the most important machines now in service, together with estimated figures for new prototypes.

Type	Power Unit			A.u.w. lb	Max. payload lb	Total Seats	Full-load performance	
	No.	Type	H.p. (each)				Range st. miles	Cruise speed m.p.h.
Bell 47G	1	Franklin 6V4	200	2,350	—	3	225	75
Bristol 171 Mk. 4	1	Leonides 73 ...	520	5,400	—	4–5	268	91
Bristol 173 Mk. 1*	2	Leonides 73 ...	520	10,600	1,600	12	100	85
Fairey Rotodyne*	2	Napier Eland	3,150	—	11,000	42	280	160
Hiller 12B (360) ...	1	Franklin 6V4	200	2,500	500	3	135	70
Percival P.74* ...	2	Napier Oryx	750	7,750	—	8–12	—	120
Sikorsky S-51 ...	1	P. & W. R-985	450	5,500	700	4	270	85
Sikorsky S-55 ...	1	P. & W. R-1340	600	6,835	1,500	5–12	350	90
Sikorsky S-56* ...	2	P. & W. R-2800	2,000	—	6,000	35	200+	140
Sikorsky S-58* ...	1	Wright R-1820	1,640	12,000+	3,000	20	—	115
S.O.1221 Djinn ...	1	T. Palouste ...	250	1,580	700	2	87	62
WS-51	1	Leonides 521	550	5,870	730	4	300	85

* These aircraft have not yet been evaluated on a commercial basis, and the figures quoted must be regarded as provisional. The Bristol 173 Mk 1 has been superseded by later developments.

Sir H. Roxbee Cox Returns to A.R.B.

THE Air Registration Board announces the appointment, as from March 3rd, of Sir Harold Roxbee Cox as an independent member of the Council, in the vacancy created by the resignation of the late Sir Maurice Denny.

Sir Harold first became associated with the A.R.B. as chief technical officer in 1938. When the war began, he was loaned first to the Air Ministry and then to the Ministry of Aircraft Production. In 1944 Sir Stafford Cripps asked the Board to release him so that he could become chairman and managing director of Power Jets (Research and Development) Ltd.; but he has remained consultant to the A.R.B. since that time, and for most of the period has been chairman of the Engines Requirements Co-ordinating Committee.

Sir Harold, who is 52 years of age, is at present director of the Brush Group, Ltd., a director of Wilmot-Breeden, Ltd., vice-chairman of the governors of the College of Aeronautics and chairman of the Civil Aircraft Research Committee of the Aeronautical Research Council.

R.A.F. Aircraft: New Facts

IN the House of Commons, on March 2nd, debate was resumed on the Government motion to approve the Statement on Defence and the Opposition amendment censuring the Government for failures in reorganizing and equipping the Services.

Mr. Selwyn Lloyd, Minister of Supply, illustrated the increasing complexity of military aircraft by remarking that a pre-war bomber carried less than 150 lb in the way of radio and electrical equipment, whereas the latest bomber carried 9,000 lb. The number of radio valves had risen from 50 in war-time to 1,000, and in a fighter from 20 to 40. Electric power required by a last-war bomber was 10kW and in a modern bomber 90kW. On the matter of development times, Mr. Lloyd remarked that the Canberra was conceived in 1944 and went into service in 1951. The Valiant specification was issued in 1948 and the type was now just beginning to enter service. It had recently been announced that the contract for the American B-52 bomber was placed in 1946, and that the type was not yet fully in service. The Russians appeared to have developed the Mig-15 remarkably quickly after British Nene engines reached them in 1947, but it was not known for what period of time before that the aircraft had been designed and developed.

Between November 1951 and the end of January 1955 the total number of aircraft delivered to the British Services was 5,500, and if the estimated deliveries for February and March were added the total was nearly 6,000. About one-eighth were jet trainers, and included were over 200 Hunters. The super-priority scheme undoubtedly contributed greatly to the results achieved. During the same time over 173 million pounds' worth of aircraft and aircraft equipment was exported.

In some quarters it had been suggested that what was now needed was a kind of "Big Brother" Beaverbrook to hustle on and energize our production. That was a complete misunderstanding of our needs. Our difficulty was essentially one of development and not of production.

Mr. Lloyd was sure that the performance of the Canberra was "considerably better than that of which its Russian equivalent is believed to be capable." The Victor and Vulcan were progressing well, both in development and production. It had been stated that there had been 325 modifications on the Hunter Mk 1 alone. That was more or less accurate. It was a normal process of development to make these modifications. During the development of the Canberra, up to 1951, 323 modifications were made. It had also been said that when the Hunter first flew in the autumn of 1951 it was discovered that the air brakes were completely unsatisfactory, and it was not until last summer—nearly three years later—that manufacture began on the modification to make the air brakes work. The inference to be drawn from that was that nothing had been done in the intervening period. In fact, three different types of air brakes were tried until one was found which was successful. The wing had been modified for carrying extra fuel. It was not true to describe this as a modification of the wing but it enabled later marks to perform certain alternative rôles. The problem of engine-stalling caused by the firing of the Hunter's guns had been very much exaggerated; it affected significantly only certain marks of Hunter, and those were not the latest. It was only liable to happen in "certain conditions of extreme altitude." The nature of the problem was well understood and measures to eliminate it were well advanced.

Mr. Woodrow Wyatt said that a deputation of shop stewards

***NO SMALL BEER:** Armstrong Whitworth Meteor N.F.11s of No. 29 Squadron achieved this commendable echelon for the benefit of an official photographer. The photograph is one of a final display at Adastral House, Kingsway, London.*

from "the Hunter factory" had been told by the firm that the Ministry of Supply had instructed the firm to cut down its aim of manufacturing thirty aircraft a month to twenty-five aircraft a month until June. That, he said, was the excuse given to them by the firm for various rearrangements which it was making.

Speaking of the development of the Supermarine Swift, Mr. Lloyd said that the Government were told that the first mark could be built to take only two Aden guns, but that a second could be produced to carry four. It was early decided that a third mark could be produced with reheat. In the course of development of these versions it was concluded that better control would be obtained by having a variable-incidence tail, and it was decided to incorporate that in the Mk 4. At the time that these early decisions were taken only two prototypes were ordered. The first production order was placed in the same month as the order for the prototypes—in November 1950. It was not until May 1953 that the first aircraft representative of the Swift 4 flew, and this was the mark to which the greater part of the orders for Swifts for the R.A.F. related. Mr. Lloyd thought that the previous Government were quite right to go for an insurance—to go for the Hunter and the Swift. It was quite true that the number of Swifts now being built, or recently being built, was brought up (Mr. Lloyd thought) in August 1952 by the present Government. The order was not quite so large as that of the previous Government. There was a later order, which was not put into execution, early in 1953. May and June 1953 had been occupied by flight testing. In July there was an engine compressor-blade failure which caused all Swifts to be grounded for two months. Testing was resumed in September, and in November an aircraft was sent to Boscombe Down. That aircraft crashed and the pilot was killed. It was replaced in December by the next available aircraft off the production line and Boscombe Down was able to begin its acceptance trials. In January 1954 there was a limited release of Mks 1 and 2 to enable crews to get practical experience as early as possible. That was done in the expectation of substantial improvements in later marks, and one R.A.F. squadron was equipped with Mks 1 and 2. Continuous testing and trials went on with a view to curing a major defect—tightening in turns—which had been found at Boscombe Down. This involved the redesign of the wing, and the redesigning took until October 1954.

It had already been announced that Swift Mks 1 to 3 would not be used operationally. About 60 aircraft of the three marks had been built. Although improvements had recently been made to the Mk 4, it was not considered that more than a limited number should be completed. Further Hunters would be ordered to replace the cancelled Swifts.

It might be said that the extent of the disappointment with the Swift should have been realized earlier, and that steps should have been taken at an earlier stage to reduce the money spent. Such steps were taken. Follow-on orders were not placed, as they would have been had the development been proceeding with comp'ete success. The manufacturers themselves did not begin production of the total number ordered, and during the past few months, in close consultation with the Government, they had been reducing the industrial effort on the Swift, with a view to saving public money in case a later cancellation should be necessary. Only in February this year were those whose responsibility it was to give advice able to say that it was no longer likely that, within a reasonable time, the Swift could be made to match the Hunter in its performance as an intercepter. When Mr. Lloyd came to his present office in October the Hunter as well as the Swift was still in difficulties, and the success of the Hunter had not been fully assured until the end of last year. He believed that the U.S. Navy cancelled over 300 million pounds' worth of orders "only the other day" because aircraft did not come up to expectations in aerodynamics.

Mr. Lloyd fully admitted that our Venom and Meteor night fighters were interim types, that they were slower and more "lightly armoured" than the latest fighters, but they were a great advance on their predecessors. Other countries might have aircraft capable of taking the air by night, and which might be in some respects superior. However, in the assessment of air defence by night, various factors had to be taken into account. In our conditions two-seaters were much more effective than single-seaters.

With guided missiles we were now making reasonably good progress, the pace of which had been governed by the decisions of six or seven years ago. There was a useful exchange with the United States. Mr. Lloyd did not think the American lead had been increased. He was anxious about the capacity to carry through without delay the extensive trials and tests which would be necessary. Production orders had been placed for one weapon, and he expected other orders to follow this year.

Since 1952 completely new control and reporting equipment had been installed. A new navigation and bombing system of very high importance had been developed since 1948 and production had begun. Another aircraft navigation system, based on entirely new principles, had been developed and was in production. Not only was the British sonobuoy system in service with the Royal Navy and the R.A.F., but it had been so successful that the United States had authorized it as part of the system for use by their own forces.

We were working on a variety of supersonic projects. There were some eleven projects "with supersonic aircraft" now in hand. The plans had been drawn up, and the technical resources, but we must guard against having too many projects and also avoid again being left in the lurch if certain of them had to be eliminated.

Development of the Javelin was making good progress; on the other hand, three had been lost in accidents during the last 2½ years. It was believed that the development problems were soluble within the range of existing knowledge. On the best technical advice this aircraft should become available in substantial numbers during the coming year.

Mr. P. B. Lucas said that it was not until W/C. Bird-Wilson was able to test the swept-wing fighters at the Central Fighter Establishment that we began to know the truth about these aircraft operationally.

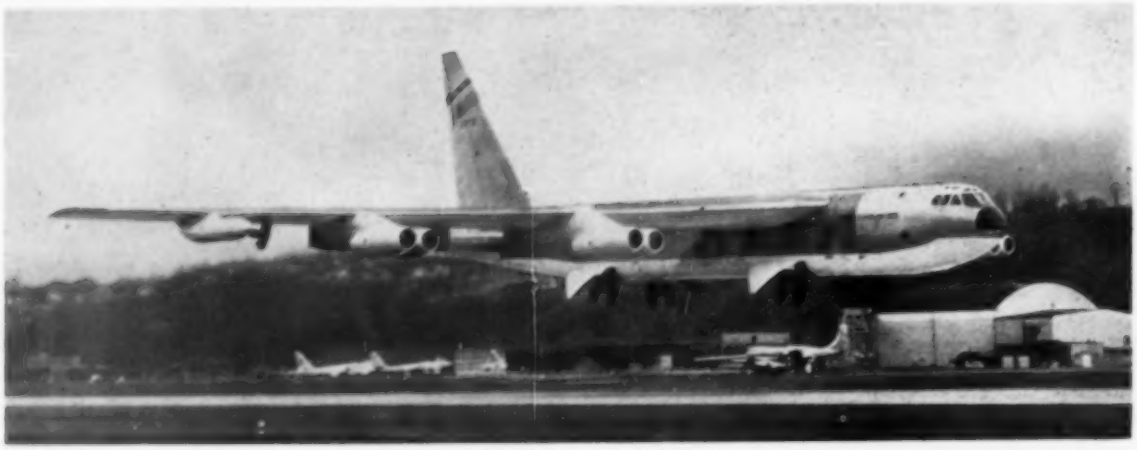
Civil Pilot Training—No Action

THE suggested scheme for the training of civil pilots, submitted as part of a memorandum by the Air League last May, has been rejected by the Government. This was the effect of an announcement made by Mr. Profumo (Parliamentary Secretary to the M.T.C.A.) in the House of Commons on February 25th. It may be recalled that this memorandum—prepared jointly by the Air League, the Air Corporations, the independent operators, B.A.L.P.A. and the Guild of Air Pilots and Navigators—proposed that financial help should be given to student pilots for the airlines by means of State scholarships.

The motion before the House was "That this House urges Her Majesty's Government to bear in mind the importance, to the future development and progress of our air service, of an adequate supply of men of the highest quality and qualifications for aircrew duties." During the discussion, Mr. Profumo referred to the conclusions of a joint Air Ministry/M.T.C.A. committee, which had investigated the supply of pilots for civil aviation.

The main conclusions were: (1) the R.A.F. would continue to provide an adequate field of civil-aviation recruitment for pilots for "at least the next seven or eight years," (2) "the age-spread, experience and technical background" of ex-R.A.F. pilots should be acceptable to civil aviation, (3) the setting-up of an independent civil-aviation flying training scheme supported from public funds was therefore not justified, and (4) the whole question of future recruitment should be reviewed after four years.

Other declarations made by Mr. Profumo in the subsequent discussion included the statement that there was no shortage of pilots at present, and—in our view, somewhat obviously—that there was no reason why operators should not themselves jointly or severally introduce a scheme for *ab initio* training of commercial pilots without State assistance. The motion, put by Sir Wavell Wakefield (St. Marylebone), was approved.



AND NOW—WHITE BOTTOMS: This impressive photograph of U.S.A.F. machine 52-8710, the first B-52A actually to be delivered, shows for the first time the reflecting finish applied to the underside to reduce the effect on the interior of heat from nuclear explosions. On this occasion, Clayton Scott (senior production test pilot) and H. S. McMurray took the B-52 to the new Boeing flight test centre at Larson A.F.B.

HERE AND THERE

Thames Helicopter Stops?

IN consultation with the Port of London Authority, the M.T.C.A. is considering—among a number of alternative proposals—a suggestion that pontoons should be used for a helicopter landing-site on the Thames. This news, announced last week-end, must have brought a wry smile to the face of W/C. Reggie Brie, i/c. B.E.A.'s helicopter unit, for he has been advocating exactly that method since his Autogiro days over 20 years ago.

B-66 Setback

ACCORDING to a U.S.A.F. spokesman in Washington, production of the Douglas B-66 twin-jet tactical bomber, U.S.A.F. counterpart of the A3D Skywarrior, described in some detail in *Flight* of February 18th, has been temporarily delayed "to correct aerodynamic difficulties."

Death of a Pioneer

M. SANCHEZ-BESA, a Chilean-born pioneer pilot who learned to fly in the early Blériot era, died in a Paris hospital last week at the age of 75. He was also a designer and constructor, and during World War I had three aircraft factories operating in France—at Sevres, Billancourt and Cognac. At the 1921 Paris Aero Show he exhibited a "multiplane" with 21 lath-like lifting surfaces arranged one above the other, venetian-blind fashion; it was powered with a British 40 h.p. A.B.C. engine.

Hope for the Flying-boat

THE only factor likely to bring about a large-scale flying-boat revival, said Mr. D. Keith-Lucas in a lecture last week, was nuclear power. It was thought that aircraft propelled by atomic energy were likely to be very large and to have a landing weight that remained equal to the take-off weight; a flying-boat was therefore the right answer. Mr. Keith-Lucas, who is a director and chief designer of Short Bros. and Harland, Ltd., and a world authority on flying-boats, was addressing the Belfast Association of Engineers.

The Higher the Fewer

A HILLER helicopter recently landed on—and took off from—a point on the Jungfraujoch 3,457m (11,343ft) above sea level, thus beating the 2,470m (8,100ft) established by another Swiss-operated Hiller which had landed near the St. Bernard Hospice. But the new "record" was short-lived, for next day an S.N.C.A.S.O. Djinn landed on the 4,105m (13,490ft) summit of the Monch. The Djinn has rotor blades driven by compressed air from a Turboméca Palouste. Last year, a Bristol Sycamore making operational trials in Kenya took off from 8,430ft.

Britannia's Tropical Trials

DEPARTURE of the first production Bristol Britannia for tropical trials in Africa and Egypt, scheduled for last Monday, was postponed until later this week after a final routine check by the pilot, W/C. Walter Gibb.

British Aircraft Data

THE world's civil transport aircraft are reviewed in this issue (pages 321-331). Readers wishing to refer to detailed data on, and illustrations of, British and Commonwealth aircraft—both military and civil—are reminded that a recent *Flight* publication, *British and Commonwealth Aircraft*, is still available. A 44-page reprint of reviews in two special issues at the time of the Farnborough Show, it is obtainable at 2s 3d (postage included) from Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1.

House Full

A LECTURE and film show given last week in a local hall by Gloster Aircraft chief photographer Russell Adams attracted such a large number of the air-minded citizens of Gloucester that dozens had to be turned away. In addition to the well-known film of the C.F.S. aerobatic team in action Mr. Adams showed another of Sea Hawks landing on and taking off from H.M.S. *Eagle*, some new shots of the Javelin and an interesting security-cleared research film showing the jettisoning of a Meteor 8 canopy with a begoggled and shivering S/L. Waterton in the cockpit.

Nuclear-power Hint

"RESEARCH into fundamental problems which govern the application of nuclear power to the propulsion of aircraft is being undertaken by the Atomic Energy Commission," according to a statement made by the Parliamentary Secretary to the Ministry of Supply in a written answer last Monday.

Spanish Rally Postponed

THE international air rally and Tour of Spain, for which preliminary plans had been announced by the joint organizers (the Spanish Royal Aero Club and the HUSA group of hotels), has been postponed until next year.

Television Post

PRODUCER of the B.B.C. television film serial *War in the Air*, Mr. John Elliot has been appointed television liaison officer to the United Nations film division in New York.

Hitting the Thousand—

DURING the past week, two of the most important American turbojets have reached the figure 1,000 in different ways. An outstanding engine is the Pratt and Whitney J57, split-compressor unit of 10,000/15,000 lb thrust; the Pratt and Whitney company announced on Tuesday that they had shipped the thousandth J57 since production started in February of 1953. Ford have also built several hundred J57s at the factory at East Wacker Drive, Chicago.

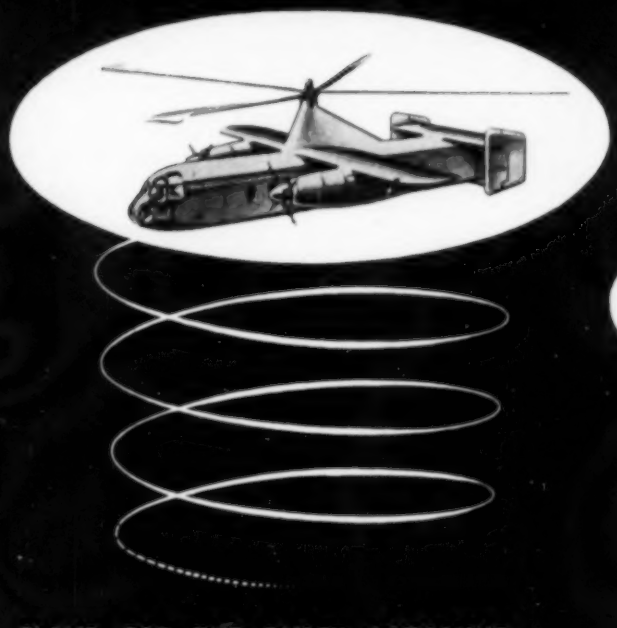
—And another

THE most widely used engine in the world at the moment is the General Electric J47 turbojet, of 5,800/7,200 lb thrust (or 8,800 with afterburner). Some 12,000 J47s are used on Boeing B-47 Stratojets (to name but one J47-powered aircraft), and one such engine—installed in a B-47 stationed at McConnell A.F.B., Wichita, Kansas—has flown 1,000 hours without major overhaul. At present 600 hours is the established overhaul life in Strategic Air Command service, but it is expected that the four-figure life will be the standard schedule from now on, owing to the excellent 600-hr condition.

MORE POWER AT LOWER COST

FOR COMMERCIAL AIRCRAFT

ELAND: *A turbo-prop engine of importance in world aviation. It has reached the type test stage at its initial rating of 3000 e.h.p. On development is a 4000/4200 e.h.p. version. Napier are installing Elands in an Elizabethan, and a Convair-Liner 340 for demonstration to airline operators.*



ELAND FOR THE FAIREY ROTODYNE: *Basically similar to the standard Eland but with an auxiliary compressor mounted coaxially at the rear of the engine. Power can either be taken through the propeller for forward flight or through the auxiliary compressor (in the form of compressed air to the rotor) for vertical flight.*

ORYX FOR THE PERCIVAL P.74: *Napier are working with Hunting Percival in the development of the Oryx turbo-gas-generator as a power unit for the P.74 helicopter.*

Napier lead the field in the application of gas turbines to helicopter propulsion.

NAPIER

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YOU'RE AN AIRY GODMOTHER, MR. PAGET

We've just caught Mr. Paget hogging the bathroom . . . today in a Milan hotel; a week today it's Madrid; and the week after, Geneva and Zurich. Mr. Paget travels as far and fast as any fairy godmother. *And he is one, too!* Because Mr. Paget (like nearly 2 million others last year) flies BEA. And his fare money helps keep British Civil Aviation on top. It enables BEA, for example, to put more Viscounts and Elizabethans in the air; to lend their advice (as major operators) to the aircraft manufacturers . . . and to give the *passengers'* point of view. Though he may not realize it, Mr. Paget is doing a pretty big job. And the more there are like him the brighter the future for British flying.

fly British IN EUROPE'S FINEST AIR FLEET

fly **BEA**

BRITISH EUROPEAN AIRWAYS

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

Award to Fighter Pilot

THE award of the A.F.C. to F/L. J. De M. Severne, in recognition of a particularly fine example of airmanship and personal courage, has been approved by H.M. the Queen.

F/L. Severne took off from Wunstorf, Germany, in a Venom last November, and was due to land at Fassberg after a routine flight. While holding the aircraft inverted at the top of a loop he smelt fumes and saw that the fire warning light was on. He righted the aircraft, jettisoned the tip-tanks and, from ten miles out and 8,000ft, decided to make a wheels-up forced landing and to preserve the aircraft so that investigations could be made. (In a similar incident, shortly before, the aircraft had been completely destroyed, leaving no evidence as to the cause of the fire.)

A belly landing on the crash strip at Fassberg was completely successful, and F/L. Severne then got out of his machine, hacked the engine cowlings off with an axe and directed a CO_2 extinguisher onto the smouldering fire he found there. He also prevented the crash-crew from blanketing the aircraft in foam, thus making it possible to investigate the cause of the fire. F/L. Severne joined No. 98 Sqn., 2nd T.A.F., last July.

No. 603 Squadron Standard

AFTER completing 25 years' service, No. 603 (City of Edinburgh) Sqn., R.Aux.A.F., is to receive its Standard from the Queen at Holyrood House, Edinburgh, on June 30th. Her Majesty is the squadron's Honorary Air Commodore.

R.N.V.R. Air Division Re-equip

DURING his House of Commons speech on the Navy Estimates, the First Lord of the Admiralty announced that the fighter squadrons of the R.N.V.R. were to be reduced in aircraft strength by about one-fifth, but equipped throughout with jet aircraft. All the air divisions will, in the course of the next few years, be re-equipped with Gannets, Sea Hawks and Seamews. The proportion of anti-submarine to fighter aircraft is to be increased.

All piston-engined fighters in the Northern and Midland Divisions, and half of those in the Southern Division, will be replaced by Attackers this year, and the introduction of Sea Hawks will begin next year. Reduction of fighter strength will involve the disbandment of one squadron in the Southern Division, and certain numerical adjustments in other squadrons. The reason given is economy.

No. 32 Squadron

THE history of No. 32 Squadron is in preparation, and the commanding officer, S/L. A. H. W. Gilchrist, appeals to all ex-members, or personnel who have in any way been connected with the unit, to let him have any relevant matter for inclusion.

He gives an assurance that all negatives, photographs or documents sent will be treated with the utmost care and returned promptly where requested.

The address is No. 32 Squadron, R.A.F. Shaibah, M.E.A.F. 20.

R.A.F. Aircraft Recognition Trophy

THE finals of the third annual R.A.F. aircraft recognition trophy competition, the largest of its kind in the world, were held last Saturday in the lecture theatre of the Science Museum, London. The trophy, a model of the Victor, and a silver cup were presented by A.V-M. the Earl of Bandon, A.C.A.S. Training. Some fifty teams from the R.A.F. and the R.O.C., as well as some from the U.S. Army's 32nd A.A. Brigade and the Royal Netherlands Air Force took part. The competition is organized by the R.A.F. Central School of Aircraft Recognition.

No. 257 Squadron, leading, and No. 43 Squadron—the "Fighting Cocks"—in formation during a recent Hunter demonstration. Both units have chequered squadron markings, No. 257 green and yellow and No. 43 black and white. "Flight" photograph

Royal Escort

THE Stratocruiser *Canopus*, bringing Princess Margaret back across the Atlantic last week from her tour of the Caribbean, was escorted throughout the flight by aircraft of the R.C.A.F. and R.A.F. Shackletons took over from Canadian maritime aircraft at 30 deg W, one machine flying ahead of, and another behind *Canopus*.

South African Shackletons

IT is officially announced that No. 35 Reconnaissance Squadron, S.A.A.F., is to be the first unit to receive the Shackleton Mk 3. This variant, which has a tricycle undercarriage, will carry equipment similar to that at present in R.A.F. Shackletons Mks. 1 and 2 and will become available next year. No. 35 Sqn., at present operating Sunderlands, is based at Durban.

A.T.C. Easter and Summer Camps

AT Easter the R.A.F. will act as host to nearly 3,600 cadets from 120 A.T.C. and C.C.F. school squadrons. Each boy will stay for one week on an R.A.F. station doing practical ground training and will be given air experience.

Arrangements are also being made for a further 30,000 cadets to be given similar training during the summer.

The snowshoes and other paraphernalia carried by these Canadian paratroops appear to belie the name of their regiment, Princess Pat's "Light" Infantry.

Executives of Fourteen Leading Aircraft Firms state their opinions for "Flight"

Makers of the World's Air Transports

From WILLIAM M. ALLEN, President, Boeing Airplane Company.

AT the invitation of the editor, two years ago, I commented in these pages on the decision of the Boeing Airplane Company to build, with its own funds, a prototype jet transport.

In the intervening period the prototype has been completed and now has more than 100 hours of successful test flying behind it. It has met or exceeded our expectations in every way. Despite two minor ground mishaps, the 707 has averaged 18 hours of test flying per month. This exceeds the utilization of any other Boeing prototype in a like period. The airplane has been flown to higher altitudes and at greater speeds than any other transport airplane. For a two-month period the 707's flight tests were conducted from a 6,000-foot taxi strip, while the main runway was undergoing repairs.

As indicated earlier, we built the 707 to demonstrate to the military the principal characteristics of a combination jet tanker and transport and, at the same time, to demonstrate to the airlines the principal characteristics of a production jet airliner.

The United States Air Force has already ordered into production a limited number of the tanker-transport, to be known as the KC-135. Tooling, engineering and other early stage production work is moving ahead at the Renton plant where the planes are to be produced.

The airlines, both domestic and foreign, have evidenced a keen interest in the 707 and any commercial version which might evolve from it. It is our belief that the proved performance and speed advantages of the turbojet engine make it the logical choice for trans-ocean and trans-continental operation. At the same time we recognize that the turboprop has application in certain fields of operation. In conjunction with the Air Force we are conducting tests of turboprop installations on two different types of aircraft.

The company is hopeful of entering the commercial field with a jet transport based on the 707. The decision is dependent on military requirements and the financial feasibility of such an undertaking.

Our 1955 production programme includes three swept-wing, multi-jet types—the B-47 medium bomber, the B-52 heavy bomber, and the KC-135 tanker-transport. We are proud of the performance of our three major designs in the multi-jet field. At the same time we are well aware that aviation never stands still and that competition is keen. We welcome such competition from our fellow manufacturers in friendly nations; it is a definite contribution to the advancement of aviation.

From SIR W. REGINALD VERDON SMITH, Joint Managing Director, Bristol Aeroplane Co., Ltd.

TWO years ago in these pages we at Bristol were reiterating the theme that efficiency in terms of operational economy must be the paramount criterion influencing an airline's choice of new aircraft. With this in mind we have pressed on consistently, despite many well-accredited arguments in favour of other criteria, to realize this doctrine of operational economy with the Britannia and its Proteus engines. And we have had the satisfaction of watching a growing interest in turboprop-powered designs among the leading airlines of the world, and an increasing number of such projects taking shape both in the United Kingdom and in the United States of America.

Britain has done more work on turboprops than any other country and the lead that we have now won in the development of this new generation of aero engines should bring us lasting benefits on the score of reliability, long life, ease of maintenance and low operating costs.

Meanwhile, in the development of new aircraft designed for higher speeds and higher altitudes, constructors are even now being faced with new problems and are having to accept new responsibilities.

More intense structural testing to guard against the risks of fatigue, and a more intensive flying programme to prove reliability prior to service—such requirements are new additions to the long list with which we are already familiar and have had their effect upon delivery programmes; but the standards which are thus being so painstakingly established will provide the new hall-mark for British design and workmanship.

**The heading illustration is a small reproduction of the 60in × 30½in world map, printed in three colours, obtainable at 15s (carriage paid) or $3.50 (U.S.A. and Canada, carriage and duty paid) from Thomas Skinner and Co. (Publishers), Ltd., 330 Gresham House, Old Broad Street, London, E.C.2.*

From SIR GEOFFREY DE HAVILLAND, Director and Designer of Aircraft, de Havilland Aircraft Co., Ltd.

THANK you for your invitation to write a message for your issue dealing with the world's airlines and their equipment. It might be unwise to forecast whether world air traffic figures will continue to increase year by year as hitherto. But one can see that the higher speeds, particularly jet speeds, and the trend towards larger airliners are both factors tending against large production quantities. Meanwhile the development cost of each new type, and the gestation period, continue to increase.

Particularly at this period, airliner development hangs upon the relative pace of advance in alternative types of powerplant. In trunk operations the need for speed on the one hand and very long range on the other suggests scope for jet propulsion and propeller turbines side by side. I am a great believer in the jet for mainline work, and an important fact is that even with a moderate payload it has a high annual work capacity. Its wonderful speed and smoothness have a strong passenger appeal. The propeller turbine has advantages in other respects.

British turbine development continues to go ahead well. The setbacks which we have had in the mainliner field should not be allowed to deter us. In the inter-city field Britain is having a notable success, and it must be consolidated, with especial care for all aspects of after-sale service to the operator.

The British industry stands in need of a bigger home market for its airliners, that is to say, increased British operations and with the element of healthy competition fostered. This requirement impresses itself at a time of awakening to the need for more mobility for the fighting services. Civil air transport, so long as it is on an adequate scale, can be counted on as a reserve for any national emergency, but a substantial organization of military transport also is a necessity. For much of the duties of military transport the civil airliner specification is suitable. Recognition of these facts would greatly help to increase the home market for airliners, on which export business can be based. We absolutely need the custom of the British operators, and must secure it on merit.

Among the handicaps from which our industry suffers in international competition there are some factors which favour us. We have an inventive genius which is outstanding, and a shrewd ability to perceive future needs. Looking back over the centuries of our history, that is not surprising. We have relatively low overheads and production costs, and a certain resiliency to programme changes. Our currency is not hard. Our industry is organized for healthy commercial rivalry, but this must not be allowed to become wasteful, for instance by the application of too many design-production teams to any one project.

If I may be permitted a word about the de Havilland outlook, I have great hopes for the Comet. Its economics are basically sound, its development has been exceptionally thorough, and I believe that it still has a valuable time-lead.

From SIR RICHARD FAIREY, Chairman and Managing Director, the Fairey Aviation Co., Ltd.

ANY study of the world's airlines emphasizes not only the complexity of operations of the main carriers, but also the large numbers of small, capable firms operating short-haul and feeder-line services throughout the world with a minimum of fuss. We tend to overlook these sometimes and to concentrate on the world-wide operation of the latest and most up-to-date fleets of the major companies. These smaller companies, and the aircraft they use, do a very important job and represent a potential market of a size comparable with that for long-range transport types. H.R.H. The Duke of Edinburgh, in his recent R.Ae.S. lecture, emphasized the importance of these operations and indicated their tremendous potentialities.

The main work of this type is at present carried out by Dakotas, the famous type that laid the very foundations of modern civil operation; they fall due for replacement during the next three to five years, and what the operator is looking for is not so much a replacement as an improvement on the Dakota, which will soon be twenty years old as a type.

Much of this replacement will be done by helicopters. On short ranges of up to 150-200 miles, helicopters of the Rotodyne type will shortly be able to compete with fixed-wing types on an economic basis and thus be easily ahead where no aerodrome facilities exist, or where the service supplies a necessity such as providing a link across a stretch of water.

The main trans-continental services can be maintained by a comparatively small number of aircraft, especially as cruising speeds get higher, and thus a major development in the air transport field in the next ten years is likely to be in the feeder-line services, making flying available to communities that have not and/or cannot have long stretches of tarmac or concrete; this applies equally strongly to internal services in this country as to services in less developed areas. The large helicopter will meet these demands.

From ROBERT E. GROSS, President and Chairman of the Board, Lockheed Aircraft Corporation.

AT Lockheed we have two groups of forward thinkers. The classic engineering department works in an atmosphere of immediacy: the man at the drawing board thinks of tomorrow and his boss thinks ahead two to four years. On the other hand, the development planning group thinks eight or ten years ahead, projecting far into the future. Management feels the pulse of both groups.

We are convinced that turboprop and jet transports will fly side by side. There is room for each. There is need for each.

The turboprop is gaining favour in United States aviation. We have R7V-2s and C-130s flying now. When the U.S. turbojet begins operation, it probably will be offered in premium service. But we feel that the turboprop will carry the bulk of first-class traffic for some time to come. Eventually it will dominate the tourist business, which itself is a fertile field.

Of course, the pure jet some day will enter high-density "coach" business too, when there is yet another and newer premium transport to supersede the first offerings. Eventually nuclear power will be used. But in the immediate future we cannot see all jets and no turboprops, or all turboprops and no jets. Nor do we see immediate ending of Wright Turbo-Compounds. These engines have behind them a large and sophisticated staff of engineers committed to developing more power and more economy.

Lockheed will deliver more Super Constellations in 1955 than in 1954, which set new company records. Scheduled for this year are new transports for ten airlines, and production is committed well into 1956. These airplanes are going to be around for a long time, earning money for years to come.

From DONALD W. DOUGLAS, President, Douglas Aircraft Company, Inc.

IMPROVEMENTS in comfort, dependability and speed of air transportation have been followed, historically, by a corresponding increase in air travel. In the United States, air passenger traffic now exceeds that of non-commuter railroad coach service, and there is every indication that further gains will be made by the swifter medium. This trend in domestic transportation follows closely the pattern already well established for Atlantic crossings.

Aware of the growing demand, airline operators have placed substantial orders for newer commercial transports which offer passengers a faster and more comfortable ride and operators an opportunity to earn a profit.

In our own recent experience, the development of a transport which offered these advantages resulted in a prompt and steady flow of orders. Domestic U.S. carriers were the first to place aircraft of the DC-7 series into operation, and the performance of these airplanes immediately attracted the bulk of trans-continental traffic. Observing U.S. developments, some operators of inter-continental airlines also elected to add newer models of long-range, piston-powered aircraft—such as the DC-7C—to their fleets.

As for the next step in commercial transports, Douglas has expended considerable time and effort toward the design of a turbine-powered airliner, called the DC-8. It will have high speed, comfort, safety and dependability as well as a unit operating cost lower than that of any of our previous transports.

The large turbine-propeller engines, now in development, show considerable promise for cargo transports. Our studies in this field indicate the possibility of developing cargo rates that could permit the growth of air shipment of freight to 30 or 40 times its present volume in the next ten to 15 years.

It has been the privilege of our company to participate in numerous dramatic developments leading to the present air age. The impact of aviation has been tremendous in scope and far-reaching in effect. In a world of peace, free of present tensions, future historians may be able to record that global commerce stimulated by civil aviation has played a leading role in the establishing of a better world.

From PROFESSOR IR. E. VAN EMDEN, Technical Director, N.V. Koninklijke Nederlandse Vliegtuigenfabriek Fokker

CALLED upon to give our views on the world's airlines and their equipment, I might emphasize that our company's attitude today does not differ from the point of view expressed by Mr. Van Meerten, co-director and chief designer of Fokker, in *Flight* two years ago.

We think that in the near future jet-propelled aircraft will find a place among other forms of long-distance planes. On the short and medium distances we definitely foresee a very extensive use of turbo-propelled aircraft. In this respect it is remarkable how completely the attitude in the United States has changed in little over one year and how airlines in that country have become turboprop-minded.

Much of the basic thinking about the turboprop for short and medium distances has been aroused by the recognized need for a completely modern aircraft of the DC-3 size. This strengthens us in our belief that the Fokker F.27 Friendship, the first flight of which is scheduled this summer and for which we are already preparing series-production for delivery by the middle of 1957, will be a useful answer to the needs of many airline operators. There are, however, two important requirements for an aircraft manufacturer to meet if he wants to put a new type in the hands of the airlines.

The first requirement is that the aircraft should be thoroughly tested. Here there is a contradiction between the development of science, creating more exacting methods and longer testing periods, and the increasing demand for faster production schemes. We feel that the answer lies in a thoroughly scheduled testing programme, in close collaboration with the civil authorities, and the possibility of "telescoping" production schedules, that can, to a certain extent, overlap the testing period.

The second dominating factor for a successful new type of aircraft will be the extent to which service and spares provisioning are assured.

We feel that these points cannot be over-emphasized. Service and spares provisioning ask for a combined policy of both manufacturer and airline, to be worked out for each special case, and only an aircraft manufacturer who is fully aware of the importance of these points will be likely to succeed.

From SIR FREDERICK HANDLEY PAGE, Chairman and Managing Director, Handley Page, Ltd.

A NEW factor is entering the long-range civil transport field. It is the low-drag, laminar-flow airliner. Recent flight trials which we have made have shown that, with boundary-layer control, laminar flow can be achieved right back to the trailing-edge of a wing. From applying this technique of drag reduction to an airliner designed *ab initio* for laminar flow great advantages will result.

For instance, a laminar-flow airliner of 150,000 lb all-up weight will carry more than 100 tourist passengers non-stop between London and New York. Its cruising speed will be considerably higher than for turboprop airliners, while its operating costs will be lower. In cruising speed it represents a stage midway between the pure-jet airliner and the turboprop transport; but its economy is far better than that of either.

In today's long-haul airline world, future needs are often sacrificed to the competitive and financial expediency of the moment. However, with the stretching gestation period of modern airliners, operators must soon face up to the need for a decision on their future requirements at an early stage.

For medium-stage main-line routes between well-equipped aerodromes, the turboprop transport has shown itself eminently suitable. But the world abounds in shorter routes between aerodromes of lower standards. Such services are often the backbone of the transport system in countries where surface transport is poor or non-existent. For routes like these special aircraft are needed.

Our new Herald, a rugged, workaday transport, is designed for such conditions. It has good take-off and landing performance and, with its four piston-engines, has the safety so necessary for operation over jungles, deserts, mountains and sea. It is versatile and carries passengers, freight or combinations of both. Furthermore, the Herald exactly fits the need of the operator, its design having followed an on-the-spot survey of operating conditions and requirements throughout the world.

A total of 29 Heralds having been ordered for Australia and Columbia, deliveries will begin in 1957. They will fill the growing gap caused by the retirement of war-surplus and now obsolescent aircraft whose basic design dates back to the early thirties.

ROLLS-ROYCE

AERO ENGINES LEAD THE WORLD

A Rolls-Royce propeller turbine engine was the first to be officially approved for civil aviation.

When technical assistance is appreciated

For over fifty years now we have been serving, in one way or another, the needs of the British aircraft industry. During this time we have tackled, quite literally, a thousand and one different jobs and this lengthy and varied experience has put us in the position of being able to provide a technical service for manufacturers that is second to none. May we also add that being right in at the beginning of a problem makes us feel very much at home and, strange as it may seem, the tougher it is the keener we are to get our teeth into it.

Helliwells Ltd — *Research, Design and Manufacture of Aircraft Components*

HEAD OFFICE: THE AIRPORT, WALSALL, STAFFS.
SALES OFFICE: 5, Clarges Street, W.1. GRO. 4653 WORKS: Aberdare, Glamorganshire, and Elmdon Airport, Birmingham

From FRANK N. PIASECKI, Chairman, Piasecki Helicopter Corporation.

IN the past, our company has not been in a position to participate in the commercial market because the production requirements of the military services have always exceeded our expanding production facilities. Nevertheless, we have always developed our helicopter designs toward commercial operation, for, although commercial sales in the helicopter industry at the present time are only a very small fraction of military sales, we have always been convinced that commercial helicopter production will one day represent a large part of the transport helicopter business.

The helicopter's ability to provide faster and more convenient short-haul transportation, with the minimum of ground installations, promises a much closer integration with everyday life than has been possible with the airplane. This has led us to believe that the development of widespread commercial operations will take place in two stages: *Stage I* is primarily concerned with the stimulation of traffic. In addition, further development of commercial operating techniques is required. *Stage II* will be the development of widespread all-weather helicopter transportation services which will start when the next generation of multi-engined transport helicopters become available embodying Stage I lessons.

Stage I is already under way in Europe with B.E.A. and Sabena, and in the United States with New York Airways, Los Angeles Airways, National Airlines and Mohawk Airlines. Such operations have already pointed out the need for helicopters possessing higher passenger capacity and being capable of operation under all-weather conditions with regularity, competitive with ground transportation.

Serious problems still remain to be solved before Stage II can be fully achieved. Primary among these is the definition of the minimum one-engine-out performance which will be desired for operation into ground transportation centres of large cities. Another serious problem is the development of practical approach and navigational aids for inclement-weather operation at low altitudes. Noise must be reduced to an acceptable level to permit operation from the centre of traffic generating areas. Heliport requirements must be defined commensurate with helicopter performance and size.

Because of the above, our policy is based on the belief that there is an immediate need for helicopters of the H-21 type to complete the developments of Stage I to the point where Stage II can be initiated. The PH-42's capacity for 19 passengers, with baggage and airline type seating, plus a cabin layout suitable for expeditious traffic handling, will generate the traffic and route systems necessary to support the operation of even larger Stage II helicopters such as our 50-passenger H-16. The greatly improved flight performance of the H-21 over previous standards will permit continued advancement of operating techniques.

Our plans are to produce PH-42s along with the military version (H-21). The commercial price will be approximately $250,000 to $275,000 [approx. £89,300-£98,250] fly-away, depending upon the amount of equipment and furnishings required.

From G. GLASSER, President, S.N.C.A.S.O.

THE development of commercial aircraft in 1954 has been greatly influenced by two factors: the Comet accidents on the one hand, and the Viscount successes on the other. Whilst the former will slow down the development of pure-jet aircraft, the latter will boost that of turboprop propulsion.

Turboprop aircraft will make rapid progress for use on secondary routes and possibly, later on, for very-long-distance mixed cargo/passenger transports.

I am nevertheless quite sure that in the future the turbojet will get the lion's share on commercial routes. It has the advantage of simplicity and it provides speed and comfort, two essential factors as far as the passenger is concerned. Its development in respect of performance and endurance is assured by the tens of millions of pounds devoted to this purpose in the military budgets of all the major aircraft-producing countries in the world.

Undoubtedly the difficulties arising in commercial aviation from the higher consumption of turbojets, and the restrictions inherent in high altitude flying, will be overcome within the next few years.

Soon the Caravelle, the S.N.C.A.S.E. twin-jet aeroplane to which, as is well known, we are contributing, will make its maiden flight. I firmly trust that it will be a great success, both from the commercial and from the technical point of view.

S.N.C.A.S.O. in their turn are going ahead with their fruitful work in the field of jet-propelled helicopters. The Djinn is a product of this series; the first delivery to operators will take place in the very near future. The study of large machines suitable for use on transport routes is progressing. However, the difficult problem of reconciling the considerable advantage of vertical take-off and landing with reasonable manufacturing costs will be solved only after much arduous work. The speed at which it will be solved will depend on the extent to which it will be possible to co-ordinate civil and military requirements.

From IGOR I. SIKORSKY, Engineering Manager, Sikorsky Aircraft Division, United Aircraft Corporation.

THE successful operations in peace and war form an ample background for anticipating the commercial transport helicopter of the future. Evidence based on current operations, as well as intense studies of future needs, indicates that transport helicopters will probably fall into two general categories—the intra-city or short-haul type, and the inter-city helicopter.

Consideration of design requirements of the first—the intra-city helicopter—point to an aircraft which will operate within a maximum distance of 60 miles from a central point. High speeds will not be necessary—a 120-knot top speed should prove ample. As this helicopter will be in direct competition with surface transport, making frequent stops of a local nature, it will not be necessary to accommodate more than 14-20, at least in the near future.

Most important designwise concerning the intra-city helicopter is that it will remain—essentially—a pure helicopter, probably an enlarged version of those flying today. Hence, some rather interesting conclusions.

Working on the basis of today's helicopter, the intra-city vehicle represents a not too radical departure in design. The 14-16 passenger machine will employ virtually all features known commonly today. Rotors, drive systems, configurations and the like will remain basically the same.

As each day teaches us something new, present design principles will be improved and simplified, thus eventually reducing costs, making operation economically feasible. Hence the practicality of the comparatively restricted payload calling for only 14-16 passengers.

Dependability of these machines, expanded to fill the needs of the intra-city helicopter, will be the primary factor in their acceptance. And we know dependability is a matter of experience.

Finally, the intra-city helicopter is a definite reality. Con-

servatively, aircraft of this type should be available to commercial operators within the next five years.

When it comes to design requirements of the second aircraft mentioned earlier—the inter-city helicopter—an entirely new group of problems confronts the engineer. The inter-city helicopter will have to cruise in from 30- to 100-mile stage-lengths. Its maximum operating distance will probably be 300 miles. If this proves so, the inter-city helicopter will in some cases compete with fixed-wing aircraft. Hence, a cruising speed of 200 or more miles per hour is desirable.

High speeds over greater distances involve greater costs, meaning, simply, size—payload will have to be increased. To make helicopters of this type economically feasible in direct operating costs, they will have to compete favourably with other means of transportation. Therefore, the payload—based on a rule of thumb 100 horsepower per passenger, similar to present fixed-wing transport operation at like speeds and over like distances—will have to be set at from 40 to 50 passengers, or equivalent cargo space.

Eventually this machine will have to be of a compound type, similar to a pure helicopter except for the addition of small wings and additional propulsive means. But for the immediate future, the inter-city helicopter will be a high performance, pure helicopter. Its cruise speed will be from 50 to 100 miles per hour less than can be expected of the later gyrodyne.

Designs presently in being will, with minor changes, adequately fulfil this immediate need and should continue to meet requirements in many areas for a considerable period. Existing markets will find this helicopter capable of profitable operation.

From M. GEORGES HEREIL, General Manager, S.N.C.A.S.E.

THE continued improvement in the quality of transport aircraft which is evident in, among other things, increased safety and endurance, places the operators in a rather difficult spot; if they seek operational economy by steadily extending the amortization period of their fleets they will run the risk of losing the market to more enterprising competitors; if they endeavour to keep up with technical developments which, far from showing signs of slowing down, seem to be steadily increasing in pace, they may have to increase their charges to a level incompatible with sound administration.

To counteract the danger of stagnation inherent in these contradictory requirements, designers and operators have the duty of resolving the problem of equipment in terms of an absolutely imperative requirement: increasing the number of customers. Lowering of charges by increasing the payload represents one means of achieving this end. It has, in fact, been applied and the limits seem to have been reached.

An increase in services, however, would seem to offer numerous possibilities; three appear to me to be particularly promising:—

(1) In densely populated areas which already possess a more or less comprehensive network of air routes, and for the main routes on less populated continents, services on medium-distance routes might be improved by increasing the frequency and by planning the time-tables. The passenger must be able to take a plane at an hour that suits him best and at a minimum reservation notice. These conditions undoubtedly apply to the internal air network of the United States. In Europe, on the other hand, on the Europe-Africa and Europe-Asia routes, and also on the South American continent, there is still room for much improvement. This is where the medium-weight transport comes in. The time economy it provides in comparison with conventional aircraft is much more useful to the passenger in respect of the increased speed of turn-round and convenient time-tables than in respect of the one or two score minutes saved on a three hours' flight. The limitation of weight and the possibility of conveying a variable proportion of passengers and freight according to requirements should contribute, by raising the load factor, to providing the customers with all these advantages without need for raising fares—it may even be possible to reduce them.

(2) In the populated areas and in hilly country quite a number of short-distance routes are just waiting for a helicopter service.

(3) In thinly populated areas it is essential to create and develop routes according to local requirements and for connection with urban centres. The necessary flying equipment should be completely independent of highly developed ground facilities. Next on the list are ease of operation, simplicity and economy. As regards connection with urban centres, fast medium-size aeroplanes are indicated.

The S.N.C.A.S.E. programme has been shaped on those lines. The Caravelle is a fast aircraft suitable for main route distances of 1,000 to 2,500 km, which can be adapted either for the transport of 70 to 90 passengers or to convey bulky freight. Construction of the two prototypes is well advanced and the first machine will fly this summer. Deliveries are planned as from 1958.

In the helicopter field S.N.C.A.S.E. are pursuing a policy directed towards exploitation of the S-55 licence and towards progressive development of new models entirely original in conception (Alouette and allied types).

The Hurel-Dubois H.D.32, for which the S.N.C.A.S.E. is responsible in respect of production and sales, is a high-power machine for short- and medium-distance routes. It will enable new air services to be created in areas having few or no ground facilities at all.

From G. R. EDWARDS, Managing Director, Vickers-Armstrongs, Ltd., Aircraft Division.

MANY of the world's airlines are now having to face up to major re-equipment programmes. In the case of the long-haul operators the orders now being placed are mainly for piston-engined aircraft. The orders for the generation of long-range aircraft which will start operation in 1960 will probably be for turbine-engined aeroplanes.

My own impression, reinforced by recent visits to the United States, is that there will be a fairly solid move towards the pure jet for the long-range transport of 1960 onwards, particularly on such routes as the American domestic coast-to-coast. The operators concerned are very conscious of the expensive nature of a wrong decision. The competitive value of relatively small increases in cruising speed is being shown up by the present position on the United States domestic airlines, and may well be intensified in the nineteen-sixties.

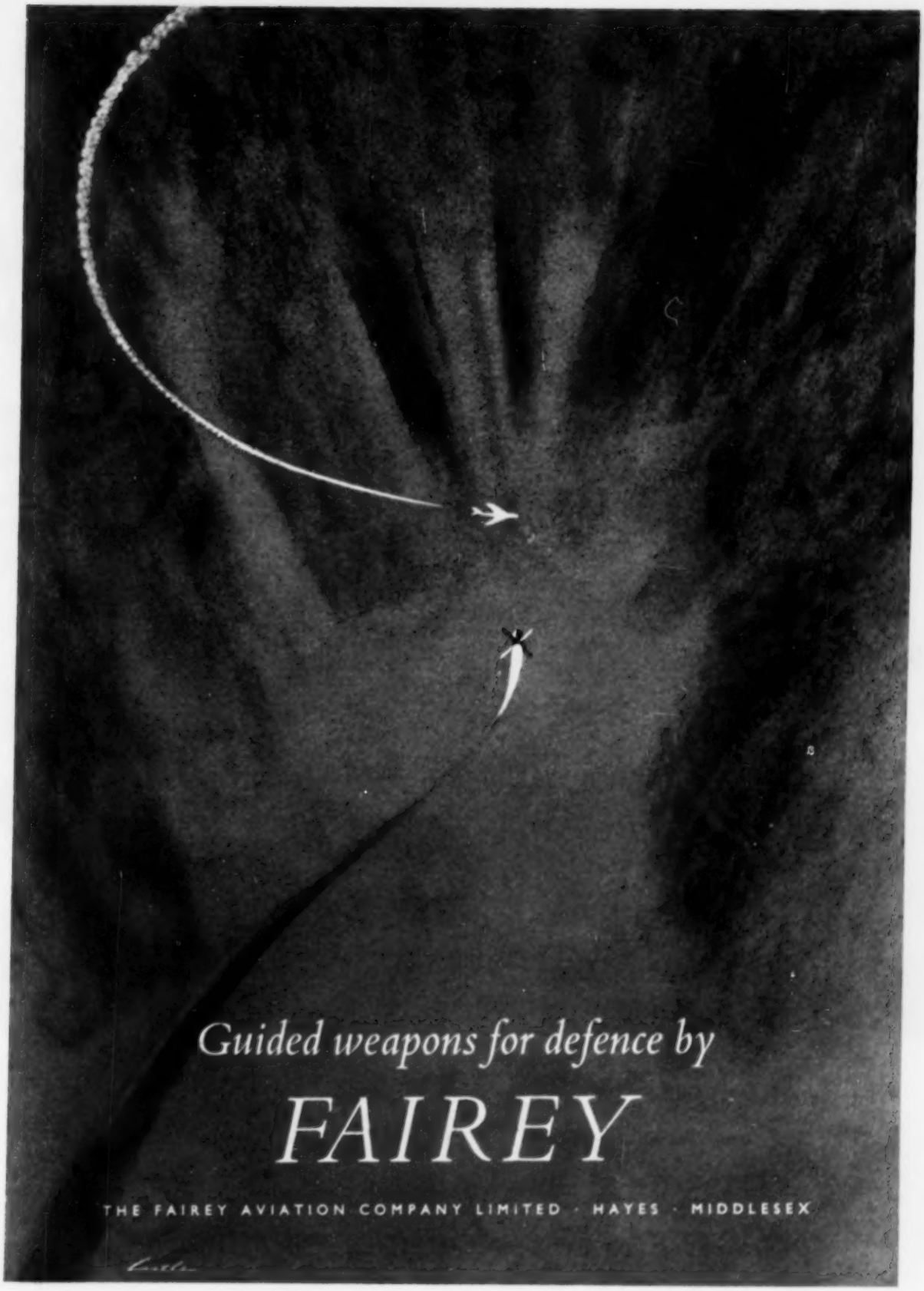
There is likely to be a strong bid from the West Coast of America for the long-range jet-propelled market. Propeller turbines for up to 2,000 miles seem to be almost universally favoured. Four engines are regarded as essential for all aeroplanes in the 40,000-lb-and-upwards size.

So far as the application of my own company's activities to meeting this situation is concerned, we have the Viscount 700 and 800 series going on and there will no doubt be further versions as the progressive development of the Dart engine makes them possible. The indications are that there will be a continuing market for the Viscount series for many years.

There is a demand for a larger, faster propeller-turbine aeroplane carrying 70-80 passengers up to 2,000 miles. We have given considerable thought to an aeroplane of this class and regard it as a fairly natural development of our Viscount aeroplanes.

The V.1000 is, in its civil form, large enough to fly the Atlantic non-stop on regular service and will compete with the West Coast long-range jets for that market.

The Americans are intensifying their efforts to retain the hold they already have on the civil aircraft markets of the world. The operating experience which is being accumulated on turbine-engined aircraft of British manufacture, allied with the undoubted superiority of British turbine engines, is our chief weapon with which to combat these efforts.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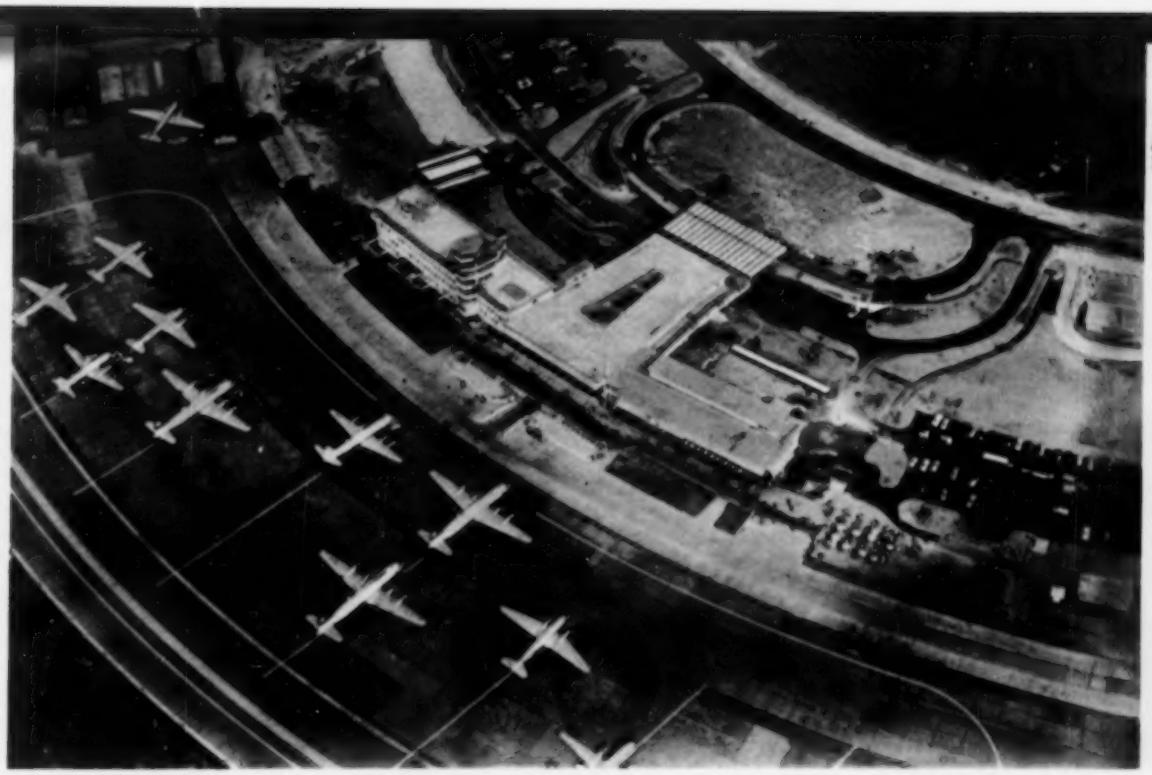


New terminal building at Kloten, Zurich. Typical transports on the apron include a Viscount, DC-3s, 4s and 6B, Viking and Convair.

AIRLINES OF THE WORLD

LISTED on the following pages are the essential facts concerning the 300-odd airlines which operate the world's scheduled services. As shown by the I.C.A.O. table below, these companies carried more than 57 million passengers in 1954.

More than half this total flew on domestic services within the United States—a point worth bearing in mind when considering the preponderance of American equipment used by the airlines; a healthy domestic market is a fine stimulus for any manufacturer.

Nevertheless, Britain has achieved a measure of success in seeking customers beyond her shores for the products of her civil-aircraft manufacturing industry. In particular, the word Viscount is now spotted with encouraging frequency among the closely printed lists of operators and their fleets. Doves, Herons, Bristol 170s, also, are distributed throughout the lists though thousands of hours and millions of miles flown may be acknowledged by little more than a line of type. This is inevitable, such is the scope of the air-transport industry today.

It will be noted that, as in previous years, the DC-3 is still serving the vast majority of short/medium-stage routes, except in the most highly developed areas. This situation will not change materially for the next year or two, though a promising future can now be forecast for at least two of the DC-3-replacement projects now under way.

On the long-haul routes, increased use of the Super Constellation and DC-6/7 series has been the only outstanding trend of the past year. The former type was adopted by Pakistan International Airlines, the sole new long-haul carrier of 1955, and will also be used by Lufthansa, shortly due to add further competition to the already keen rivalry between European airlines.

On the pages which follow, complete fleet lists are given wherever possible, together with details of aircraft on order; it will be seen that a high proportion of carriers has not yet decided on the type of equipment which best suits their routes and, possibly, their budget. In most cases we have also quoted the number of passengers carried and revenue ton-miles flown by the airline concerned in the calendar year 1954. Where possible, we have used data supplied direct by the airlines. When 1954 figures have not been available, statistics for the preceding year have been included, in order to provide a basis for comparison between companies.

The British Airways Corporations are the subject of special study on the two pages overleaf; other airlines are listed in alphabetical order on pages 304-308 inclusive.

SCHEDULED AIR TRAFFIC IN 1954—I.C.A.O. STATISTICS

	Miles flown	Pass.	Pass. miles	Cargo ton-miles	Mail ton-miles	Av. No. pass. per a/c.	Av. miles per pass.
			(millions)				
1954	1,206	57.8	32,000	716	217	26.5	554
1953	1,156	52.0	28,580	696	188	24.7	551
1952	1,059	45.0	24,540	668	175	23.2	547
1951	976	39.9	21,380	620	160	21.9	536
1950	890	31.2	16,960	518	143	19.1	544
1949	836	26.5	14,480	390	128	17.3	546
1948	789	23.5	12,990	286	114	16.5	552
1947	708	21.0	11,740	187	88	16.6	559
1946	584	18.2	9,630	82	67	16.5	529
1945	373	9.3	5,100	77	90	13.7	548
1937	165	2.5	880	n.a.	n.a.	5.3	350
	Percentage Increase or Decrease Between Years						
1953-54	+4	+11	+12	+3	+16	+7	+1
1947-54	+70	+175	+172	+283	+148	+60	−1
1952-53	+9	+16	+16	+4	+7	+6	+1
1951-52	+9	+13	+15	+8	+9	+6	+2
1950-51	+10	+28	+26	+20	+12	+15	−1
1949-50	+6	+18	+17	+33	+12	+10	−1
1948-49	+6	+13	+11	+36	+13	+5	−1
1947-48	+11	+12	+11	+53	+30	−1	−1
1946-47	+21	+15	+22	+128	+31	+1	+6
1945-46	+57	+96	+89	+6	−26	+20	−3

Not included: U.S.S.R. and the People's Republic of China.
n. a.—Not available.

	1954	1953	Percentage variation
Capacity ton-miles offered	286,298,032	212,718,813	+3.0
Load ton-miles sold	132,762,149	137,180,871	−3.2
Revenue load factor	64.4	64.5	−0.2
Seat-miles available	1,405,342,236	1,444,908,683	−2.8
Passenger-miles flown	879,973,683	914,590,316	−3.5
Passenger load factor	62.6	63.2	−1.0
Passengers carried	282,633	289,379	−2.3
Mail ton-miles flown	17,097,812	17,328,409	−1.4
Freight ton-miles flown	23,604,872	22,505,751	+4.9
Average staff (1953-54) (1952-53)	17,270	17,669	−2.2

B.O.A.C.

THE AIRWAYS

IN common with the other major airlines B.O.A.C. have experienced a great increase in their volume of business since the end of the war—from 115,000 passengers in 1947-48 to 305,000 in 1953-54. Over the last two years, however, there has been a marked flattening in the increase curve and in the calendar year 1954 B.O.A.C.—alone among the big international carriers—experienced a drop in traffic. This was caused simply by the airline's lack of aircraft to meet all the demands of its 80,000-mile network of routes, following withdrawal of Comet 1s from the African and Eastern lines and the subsequent non-delivery of Comet 2s intended for service over the South Atlantic. The loss last year of a Constellation and a Stratocruiser had a further adverse effect on the equipment situation. The direct result of the aircraft shortage was the complete suspension of B.O.A.C.'s South American services and the curtailment of some others; there were also serious effects on the Corporation's long-term planning programme. First the Corporation was forced to buy second-hand aircraft—eight Stratocruisers and seven Constellations—to cover its immediate needs; then, feeling it necessary to ensure against any possible repetition of such a situation, B.O.A.C. asked for Government approval to buy DC-7Cs for delivery late in 1956. Permission to buy ten of these aircraft, which are intended primarily to operate a competitive non-stop service across the North Atlantic, was granted about two weeks ago.

It is a tribute to the courage and resilience of the Corporation that it has so far maintained its competitive position and that its fine reputation for service and efficiency has not in any way been tarnished by events of recent months.

Though losses of as much as £7m annually were incurred in the first post-war years, the Corporation is now in a healthy financial state. An operating profit has been achieved for the last three financial years, the net profit in 1953-54, after payment of interest on capital, being £936,911. The high average utilization of the Corporation's fleet—last year flying time on scheduled services totalled 141,076—has been an important factor behind the improved finances. A small profit is foreseen this year.

During 1953-54 the average distance flown by each B.O.A.C. passenger was 3,143 miles—a figure which is claimed to be substantially higher than that of any other major airline. There has lately been a notable increase in the proportion of passengers making use of B.O.A.C.'s tourist-class services—from 28 per cent in 1953 to over 40 per cent last year.

An important feature of the Corporation's programme for the coming year will be the operation of Stratocruisers on all services across the North Atlantic. This has been made possible by an increase in the strength of the Stratocruiser fleet, which now totals 16 aircraft, two of which have been bought from P.A.W.A. and six from United Air Lines. Nine of the fleet are at present in operation and the remaining seven are being converted in preparation for the forthcoming busy season. The Corporation's fleet of Constellations also numbers 16 aircraft—12 L.749As and four L.049s. The Constellation 049s will be replaced by 749s during the next few months under a barter agreement between B.O.A.C. and Capital Airlines whereby the British airline receives seven of the later type aircraft which have a longer range in return for seven 049s plus $3,850,000.

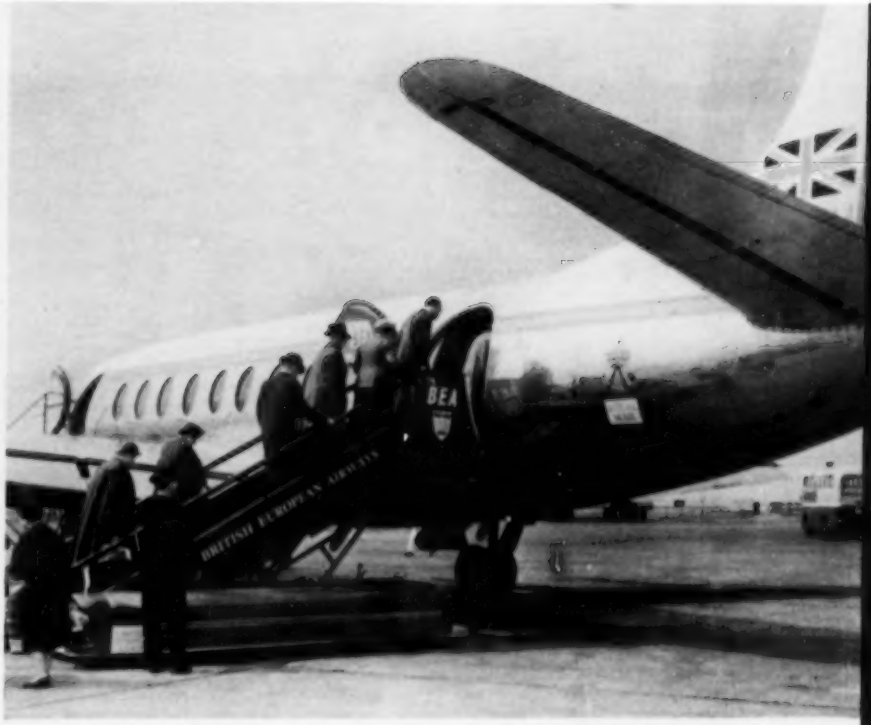
Constellations are at present operating some of B.O.A.C.'s Atlantic tourist services as well as services to Sydney (this route is flown in partnership with Qantas who use Super Constellations) and to Ceylon. Under the forthcoming redeployment programme it is likely that Constellation services will be introduced to some of the African and Eastern routes now flown by Argonauts. B.O.A.C. have a fleet of 22 Argonauts which are used on both first-class and tourist services. Six York freighters represent the only other type of aircraft used by the Corporation, the Hermes IVs having finally been withdrawn.

To replace their existing fleet of 60 piston-engined aircraft B.O.A.C. have ordered a total of 63 new aircraft of three different types, each type employing one or other of the three main classes of power unit offered for long-range transports—the compound piston-engine, the turboprop and the turbojet. The decision to continue to use piston engines, was however, an insurance measure, and it is hoped that eventually B.O.A.C.'s equipment will consist solely of British turbine-powered aircraft—Britannias and Comets. Thirty-three Britannias are on order, 15 of which will be Mk 100s for delivery in 1956-57 and, subsequently, for introduction on Commonwealth routes. The remaining 18 will be more powerful, larger Mk 300s, and ten of these will be "L.R." versions with tankage for transatlantic non-stop operations. The order for DC-7Cs was approved with the proviso that the American aircraft should be re-sold when Britannia 300 L.R.s are available for transatlantic routes. B.O.A.C. are likely to be the first airline to re-introduce jet travel when "New Comets" are ready for scheduled service—probably in 1957. Twenty such Comets have been ordered by the Corporation.

Top, work on Stratocruiser "Canopus," which carried Princess Margaret on her recent tour. Below, Argonaut "Atalanta" taxies in.

	1954	1953	Percentage variation
Capacity ton-miles offered ...	95,258,000	80,905,000	+17.8
Load ton-miles sold ...	61,636,000	51,951,000	+18.8
Revenue load factor ...	64.7	64.3	+ 0.6
Seat-miles available ...	822,068,000	696,706,000	+18.0
Passenger-miles flown	557,010,000	463,541,000	+20.1
Passenger load factor	67.8	66.6	+ 1.8
Passengers carried ...	1,839,221	1,630,690	+12.3
Mail ton-miles flown ...	2,846,000	2,569,000	+11.0
Freight ton-miles flown	5,692,000	5,561,000	+ 2.3
Average staff	9,112	8,876	+ 2.6
Staff at December 31st	8,903	9,042	— 1.5

B.E.A.



CORPORATIONS

WITH one of Europe's most efficient short-haul fleets, B.E.A. has continued to reduce its direct operating costs during the past year. This modern fleet has had another effect on the Corporation's financial results, however: the increase in amortization charges of almost half a million pounds, recorded in the annual report for 1953-54, was a major item leading to the increase in net deficit to £1,773,797.

Before providing for amortization and depreciation, however, an operating surplus of £64,000 was achieved, compared with a loss of £450,000 on the same basis during the previous year. Other results given in the last annual report include the facts that the specific cost was reduced by 6.1 per cent against a fall in revenue rate of 8.5 per cent; the operating-revenue rise of 13 per cent was matched by an increase in total expenditure in the same proportion; and a net profit of £301,000 was earned by Viscount aircraft. Subsequently, operating costs have been reduced still further.

Traffic figures for the 1954 calendar year are given above. Mr. Peter G. Masefield, chief executive, has said that, during 1954, the airline's deficit was reduced by rather more than one million pounds, so that, over the year, it stood at the lowest point in B.E.A. history.

An interesting route analysis of the London-Paris sector flown by B.E.A. Elizabethans during 1954 shows that 59 per cent of the total air traffic between the two cities was flown by the Corporation. The number of passengers carried increased by 12½ per cent to 235,000 and, from a revenue of £1,560,000, a small net profit was made—believed to be the first by any airline on this route since services began in 1919.

The year 1954 saw the continuance of the popularity and profitability of both Elizabethans and Viscounts. At January 1st, 1955, the Corporation's fleet consisted of 20 Elizabethans, 23 Viscounts (present strength 24), 46 Pionairs, 30 Vikings, 8 D.H. 89A Islanders, two Bell 47B3s, two Bristol 171s and one Westland Sikorsky S-55. Since added are two D.H. Herons (B.E.A. "Hebrides" class), which are shortly to go into passenger and ambulance service in Scotland. A second S-55 is on order; both are planned to be used on a 19-mile route between London Airport and the South Bank site, Waterloo. In June 1954 the first scheduled passenger helicopter service to be operated with Bristol 171s was inaugurated, between London Airport and Eastleigh Airport (Southampton), and in April a new scheduled fixed-wing service to Biarritz was commenced, using Vikings.

A change in the organization structure of B.E.A. was made in March 1954 when the commercial director was made directly responsible to the chief executive, and flight operations and traffic departments came under the controller of operations. There are now four main divisions under the chief executive: Operations (traffic, and flight operations), Engineering, Commercial and Finance and Property. The first includes all area managers.

After eight years of B.E.A. operations, Northolt Airport closed down at the end of October, after which time all the Corporation's London services used London Airport. B.E.A.'s new engineering base at L.A.P. which came into full use during 1954, is acknowledged to be one of the world's best.

Top, the popular Viscount. Centre, the new "Hebridean" Heron. Below, the ubiquitous Pionair.

Aer Lingus Viscount flagship at Dublin Airport.

WORLD AIRLINE DIRECTORY

Operators of Scheduled Passenger, Mail and Freight Services

ADEN AIRWAYS, LTD., Aden. (Owned by B.O.A.C.). Operates some 6,000 miles of routes in Arabia, Africa and Near East with six DC-3s.

Aer Lingus Tta. (Irish Air Lines), Dublin. (Associate of B.E.A.). Operates services between Dublin and Shannon and from Ireland to England, Scotland, Isle of Man, Wales, Channel Islands, France and Holland. Fleet: four Vickers-Armstrongs Viscounts and 12 Douglas DC-3s. In 1954 Aer Lingus carried 336,192 passengers and flew 8.7m ton-miles.

Aeroflot, Moscow. The Soviet national airline. Routes throughout U.S.S.R. and to bordering countries with Il-12s, Li-2s (Russian DC-3s) and other aircraft.

Aerolineas Argentinas (Argentine Airlines), Buenos Aires. The principal Argentine airline, operating domestic services and to West Africa, Portugal, Spain, Italy, France, Germany, Holland and United Kingdom. Fleet: six Douglas DC-4s, five DC-4s, 18 DC-3s, four Convair 240s and six Short Sandringhams. In 1954 the airline carried 280,643 passengers.

Aeronaves de Mexico, S.A., Mexico City. Operating domestic routes with eight DC-3s, three Convair 340s and a DC-4.

Aero Nord Swedan A.B., Stockholm. Newspaper and limited domestic passenger services with Lodestar and Consul.

Aeronorte (Empresa de Transportes Aéreos Norte do Brasil, Ltda), Sao Luiz. Services in North Brazil with Percival Princes.

Aero Transportes, S.A., Mexico City. Local services with three DC-3s.

Aerovias Brasil (Empresa de Transportes Aereovias Brasil, S.A.), Rio de Janeiro. Domestic services and routes to Dominican Republic, Trinidad, Venezuela and U.S.A. DC-4s, DC-3s and C-46s.

Aerovias Ecuatorianas, C.A., Quito. Local services and to Panama and U.S.A. DC-3s and Boeing Stratoliners.

Aerovias Guest, S.A., Mexico. Operates from Mexico City to Florida with a fleet of three DC-4s. Passengers carried in 1953 totalled 39,000.

Aerovias Nacionales de Columbia, S.A., Bogota. (An affiliate of Pan American World Airways.) Operates in South America and from South America to Jamaica, the U.S.A., Bermuda, Azores, Spain, France, Portugal and Germany. Fleet: three L.1049E Super Constellations, one Constellation 749A, 13 DC-4s, 36 DC-3s and five C-46s; one L.1049G on order. A subsidiary, Aerotaxi, Ltda., has 12 Cessna 195s and three Beavers. Last year the parent line, known as Avianca, carried 836,636 passengers and flew some 43m ton-miles.

Aerovias "Q" S.A., Havana. Operates from Cuba to Florida with three DC-3s and three C-46s. Last year the company carried 108,207 passengers.

Aerovias Reforma, S.A., Mexico City. Domestic routes with DC-3s.

Aerovias Transcontinentales, S.A., Mexico City. Domestic routes with DC-3s.

Aerovias Venezolanas, S.A. (Avensa), Caracas. (Associate of P.A.W.A.) Domestic routes with 17 DC-3s, three DC-4s and three Convair 340s. Last year's traffic: 287,066 passengers and 6,250,000 ton-miles.

Aigle Azur, Paris. Services to Indo-China, French Equatorial and West Africa and Madagascar with Boeing Stratoliners, five of which were in service in 1953, when the airline carried 9,563 passengers.

Air Atlas—Air Maroc (Compagnie Chérifienne de Transports Aériens), Casablanca. Services in North Africa and to France, Italy and Switzerland with five DC-3s and four DC-4s; a fifth DC-4 is due for delivery this month. Last year the airline carried 90,171 passengers and flew 5.3m ton-miles.

Air Ceylon, Ltd., Colombo. Services to India with DC-3s.

Air France (Compagnie Nationale Air France), Paris. Operating one of the largest route-mileages in the world with European network, services to North and South America, throughout Africa, to the Near, Middle and Far East and Australia. Fleet: three de Havilland Comet 1As, 12 Vickers-Armstrongs Viscounts, 20 Constellation 749As, nine Super Constellations, 20 Douglas DC-4s, 37 DC-3s, 11 Breguet Provence and five Morane 733 trainers. On order: ten L.1049Gs and one Provence. Last year Air France carried 1,551,605 passengers.

Air-India International Corporation, Bombay. The Indian international long-distance airline linking India with Egypt, Italy, Switzerland, France, Germany, the United Kingdom, Aden, East Africa, Hongkong and Singapore; routes to Tokyo and Canton are planned. Soon to open services to Tokyo. Fleet: four Constellation 749As and two Super Constellations. On order: three Super Constellations (now in process of delivery). Last year Air-India International carried 30,556 passengers and flew 11,073,000 ton-miles.

Air Jordan, Amman. Services from Amman to Jerusalem, Cairo, Beirut, Damascus and Dhahran with three DC-3s.

Air Laos, Vientiane. Local services with one Stratoliner, seven DC-3s, two Bristol 170s and one Beaver. Last year Air Laos carried 26,458 passengers.

Air Liban, Beirut. Service in Near East with five DC-3s and two Languedocs.

Airlines (W.A.), Ltd., Perth. Services within Western Australia with four Doves.

Airtaxa, A.B., Stockholm. Newspaper and limited domestic passenger services with Lockheed twins.

Air Vietnam, Saigon. Local services and to Hongkong and Thailand. DC-3s, DC-4s and Bristol 170.

Alaska Airlines, Inc., Anchorage. Domestic routes and to U.S.A. DC-3s, DC-4s and other types.

Alaska Coastal Airlines, Juneau. Local services with seven Geese, one Widgeon, one Catalina, one Vega, one Pacemaker, two Pacers and one Seabee. Traffic last year: 42,533 passengers and 483,214 ton-miles.

Alitalia (Aerolinee Italiane Internazionali), Rome. (Associate of B.E.A.). Operates services between Rome and Turin and from Italy to Libya, France, Switzerland, Greece, the Lebanon, Egypt, Portugal, Venezuela, Brazil, Uruguay, Argentina, Sudan and East Africa. Fleet: three Convair 340s, four Douglas DC-6Bs and four DC-4s.

Allegheny Airlines, Inc., Washington, D.C. Eastern States local-service with 15 DC-3s. Traffic for 1954: 276,833 passengers and 4,411,722 ton-miles.

American Airlines, Inc., New York City. Operates extensive system from Eastern seaboard to California with services extending south to Mexico City. The company is the largest airline in the world, as the following figures show: revenue earned in 1954, $214,766,204; revenue-miles flown, 99,736,407; passenger-miles flown, 3,456 million. The number of passengers carried by A.A. last year was approximately 6m. At September 30th the fleet consisted of 76 Convair 240s, 50 DC-6s, 25 DC-6Bs, 24 DC-7s, nine DC-4s and three DC-6As.

Ansett Airways, Pty., Ltd., Melbourne. Network of services to Hayman Is., Hobart and Lord Howe Is. The fleet consists of six DC-3s, two Sandringham flying-boats and 2 Convair 340s. Last year Ansett carried 165,465 passengers and 5,750 tons of freight.

Arab Airways (Jerusalem), Ltd., Amman. (Associate of Aden Airways.) Routes from Amman to neighbouring countries and to Aden with three DC-3s. Last year's traffic:

Bristol 170 of Aviacon y Commercio (Madrid).

Heron 1 of Braathens S.A.F.E. (Norway).

20,720 passengers carried, 1,382,930 ton-miles flown.

Arctic Wings, Ltd., Churchill. Services in Hudson Bay area. Norseman and Anson.

AREA—see Aerovias Ecuatorianas.

Arkia (Israel Inland Airlines, Ltd.), Tel Aviv. Domestic routes with one D.H.89 and one C-46; three DC-3s will be introduced in May. Last year Arkia carried 10,463 passengers and flew 58,680 ton-miles.

ATSA—see Aero Transportes.

Australian National Airways Pty., Ltd., Melbourne. Extensive network in Australia, linking Melbourne, Sydney, Brisbane, Hobart, Adelaide, Perth and other points. Fleet: two Douglas DC-6Bs, two DC-6s, eight DC-4s, 19 DC-3s and three Bristol 170s; on order, an unspecified number of Handley Page Heralds. In 1953 A.N.A. carried 570,335 passengers.

Aviacion y Comercio, S.A., Madrid. Domestic services and to Algiers, Canary Isles, Belgium and Holland. Fleet consists of four Bristol 170 Mk 21s, two 170 Mk 31s and two Languedocs. Last year the airline, known as Aviaco, carried 182,810 passengers and flew 3.8m. ton-miles.

Aviateca—see Empresa Guatemalteca Aviacion.

Baca Airlines, Jefferson City. Local services. Cessnas, Stinson Reliants and Bonanzas.

Bahamas Airways, Ltd., Nassau (Subsidiary of B.O.A.C.) Local services with five Grumman Goose.

Bonanza Airlines, Las Vegas. Local services in Nevada, Arizona and California with five DC-3s.

Braathens South-American and Far East Airtransport, A.S., Oslo. Services from Oslo to Stavanger and Trondheim with two DC-4s, one DC-3 and three Herons; on order, one Viscount for delivery in 1956. Last year the company carried 27,218 passengers and flew 1,150,000 ton-miles.

Braniff International Airways, Dallas, Texas. Routes in the U.S.A. extending from Minneapolis-St. Paul and Chicago south to Gulf cities and through Cuba and Central America to Brazil and Argentina. Fleet: nine DC-6s, 23 DC-3s and 24 Convair 340s. Last year Braniff carried 1,496,163 passengers and flew 68,129,567 ton-miles.

British Colonial Airlines, Inc., Belize. Local services in British Honduras with three Cessna 170s, and one Aero Commander.

British European Airways Corporation—see p. 303.

British Guiana Airways, Ltd., Georgetown. Local services and to B.W.I. DC-3s and Grumman Goose.

British Overseas Airways Corporation—see p. 302.

British West Indian Airways, Ltd., Port of Spain. (Owned by B.O.A.C.) Routes in West Indies and to Miami. Fleet: five Vikings and three DC-3s; four Viscounts on order for delivery this year. In 1954 B.W.I.A. carried 66,650 passengers and flew 2,238,300 ton-miles.

Butler Air Transport, Pty., Ltd., Sydney. Local services with six DC-3s and two Herons; two Viscounts on order, for delivery in 1955-56. Last year Butler carried 156,643 passengers.

California Central Airlines, Burbank. Local services in California with four Martin 2-0-2s, two DC-3s and one Lockheed 12A.

Canadian Pacific Airlines, Ltd., Vancouver. Routes in Eastern and Central Canada and from British Columbia and Alberta to the north. Trunk routes: Vancouver-Honolulu-Fiji-Auckland-Sydney; Tokyo-Vancouver and Hongkong - Tokyo-Vancouver-Mexico City-Lima. The company will shortly introduce a trans-Arctic service from Vancouver to Schiphol, Amsterdam. Fleet, 15 DC-3s, five Convair 340s, four DC-6Bs, one DC-4, two Norseman Vs, one Anson V, one Canso and one Vinionaire. In 1954 C.P.A. carried 231,131 passengers and flew 23,436,522 ton-miles.

Capital Airlines, Inc., Washington, D.C. Extensive route network in Eastern, Southern and Mid-Western States. Fleet: 25 DC-4s, 12 Constellations and 21 DC-3s. Capital have ordered 60 Viscounts, with first deliveries this spring. Last year the airline carried 2,426,961 passengers.

Caribair (Caribbean Atlantic Airlines, Inc.), San Juan. Domestic services to Dominican Republic and Virgin Is. with three DC-3s.

Caspar Air Charters and Agencies, Ltd., Nairobi. (In conjunction with E.A.A.C.) Local services with four D.H.89s, and four smaller types.

CAT—see Civil Air Transport.

Cathay Pacific Airways, Ltd., Hongkong. Routes to Singapore, Bangkok, Calcutta, Rangoon and Indo-china. Fleet: one DC-6, one DC-4 and two DC-3s. Last year Cathay Pacific carried 18,164 passengers and flew 2,525,000 ton-miles.

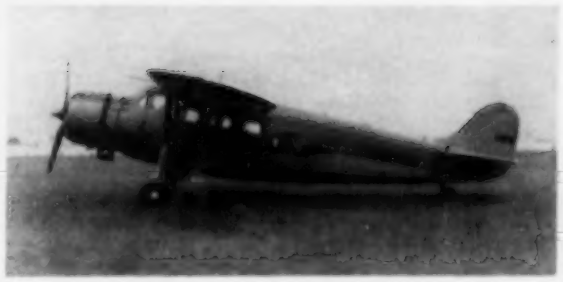
CAUSA—see Compania Aeronautica Uruguaya.

Central African Airways Corporation, Salisbury. Services in Central Africa and to South Africa and United Kingdom. Fleet: four Viking 1s and six Viking 1Bs, six DC-3s and six Beaver 2Cs. On order, five Viscount 700Ds, with deliveries beginning late in 1955. Last year's traffic: 131,431 passengers and 7,100,000 ton-miles.

Central Airlines, Fort Worth, Texas. Local services with nine DC-3s. Last year the airline carried 59,209 passengers and flew 931,511 ton-miles.

Central Northern Airways, Ltd., Winnipeg. Local services. Fleet includes one Beaver, six Ansons, two Electras and eleven Norsemen, one Bellanca, two Stinsons, one Cessna, two Wacos and two PBY5As. In 1954 the company carried 12,267 passengers and flew 62,262 ton-miles.

Civil Air Transport (CAT) Taipeh. Domestic routes and to Manila, Hongkong, Bangkok, Okinawa, Japan and Korea. Fleet; 23 C-46s, five DC-3s, two DC-4s and two Canso amphibians. Purchase of two DC-6s "under consideration." In 1954, the airline, which is known as CAT, carried 143,002 passengers and flew 13,363,017 ton-miles.



Faucett-Stinson (F-19) of Compañia de Aviación Faucett.

Colonial Airlines, Inc., New York City. Routes in the Eastern States, to Canada and Bermuda. Fleet: five Douglas DC-4s and eight DC-3s. In 1954 Colonial carried 436,059 passengers and flew 13,515,374 ton-miles.

Commercial Air Services (Pty.), Ltd., Johannesburg. Local services with three Lodestars and four Cessna 170s. Traffic in 1954: 7,439 passengers and 38,634 ton-miles.

Compagnie Générale de Transports Aériens—Air Algérie, Algiers. Services in North Africa and to Majorca, France and Switzerland with two DC-3s and four DC-4s. Two DC-6Bs have been ordered, for delivery in June and September respectively. Traffic in 1954: 104,789 passengers and 7m ton-miles.

Compania Aeronautica Uruguaya, S.A., Montevideo. Services linking Uruguay and Argentina with three Sandringhams.

Compañia Cubana de Aviación, S.A. (Cubana), Havana. Domestic services and to Guatemala, Mexico, Salvador, the U.S.A., Bermuda, Azores, Portugal, Spain and Haiti. Fleet: three Lockheed Constellations, six DC-3s, and four C-46s. On order: two Super Constellations. In 1954 Cubana carried 232,645 passengers.

Compañia de Aviacion Faucett, S.A., Lima. Local services with seven DC-3s, four DC-4s and four two D.H.82s and one Beechcraft D-17.

Continental Airlines, Inc., Denver. Routes from Denver to Kansas City and St. Louis in the east, San Antonio and El Paso in the south with through-aircraft service to California and Houston. Fleet: two DC-6Bs, seven Convair 340s, ten DC-3s and one Convair 240 and one DC-6B on lease.

COPA (Compania Panamena de Aviación, S.A.), Panama City. (Associate of P.A.W.A.) Local services with DC-3s.

Cordova Airlines, Inc., Anchorage. Local services with two DC-3s, three Cessna 170s, two Piper PA-14s, one Stinson, one Piper Supercub and one Aeronca Sedan.

Corps d'Aviation de l'Armée d'Haiti, Port au Prince. Local services with DC-3s, C-46s and one Boeing Stratoliner.

CSA (Ceskoslovenské Aerolinie), Prague. Domestic routes and to East European countries and Scandinavia. DC-3s and Il 12s.

Cyprus Airways, Ltd., Nicosia. (B.O.A.C. and B.E.A. Associate.) Route network in Near East and to North Africa. Fleet of DC-3s, Viscounts operated by B.E.A. in association to Athens and Beirut. In 1953 Cyprus Airways carried 30,594 passengers and flew 1.6m ton-miles.

Delta C. & S. Air Lines, Atlanta, Ga. Operating from Chicago in the north to Houston and Miami in the south with international routes to Cuba, Jamaica, Haiti, Dominican Republic, Puerto Rico and Venezuela. Fleet: ten Douglas DC-7s, seven DC-6s, 20 Convair 340s, three Constellation 649s and two DC-3s. Traffic in 1954: 1,837,537 passengers, and 736m passenger-miles.

Deutsche Lufthansa, Hamburg. This airline is due to start operating European domestic services on April 1st with four Convair 340s; eight Super Constellations have been ordered for long-range routes and three DC-3s will be used for freight services and as standby aircraft.

Deviet Hava Yollari—Turkish State Air Lines, Ankara. Domestic Services and to Lebanon, Cyprus and Greece. Fleet: ten DC-3s and seven

Central Airlines DC-3 (left) and Air-India Super Constellation.

"Faucett-Stinsons." In 1954 the airline carried 133,299 passengers.

Compania Dominicana de Aviación S.A., Ciudad Trujillo. Domestic routes and to Puerto Rico and U.S.A. Two DC-3s and four C-46s, and one Beaver.

Compañia Mexicana de Aviación, S.A., Mexico City. (Affiliate of P.A.W.A.) Routes are domestic and to Cuba and U.S.A. Fleet: 15 DC-3s, six DC-4s, four DC-6s and four DC-3s. In 1954 the company carried 428,179 passengers and flew 13m ton-miles.

Compania Itaú de Transportes Aéreos, Rio de Janeiro. Domestic freight services with nine C-46s.

Connellan Airways, Ltd., Alice Springs. Local routes with three D.H.89s, two D.H.90s, one Aiglet,

(Above) Douglas DC-6 of Compania Mexicana de Aviacion. (Below) The first of J.A.T.'s Convair 340s.

WORLD AIRLINE DIRECTORY . . .

Heron 2s (now in process of delivery). Last year DHY carried 147,693 passengers and flew 7.5m ton-miles.

Divisao de Exploracao dos Transportes Aereos, Lourenço Marques. Domestic routes and to S. Rhodesia and South Africa. Fleet: three DC-3s, six Doves, two Hornet Moths, one Dragon Fly, four Dragon Rapides, two Junkers 52/3ms, one Lockheed 14H and two Lodestars.

Divisao de Exploracao dos Transportes Aereos, Luanda. Routes in W. Africa. Fleet: four DC-3s, five Beech 18s and seven Dragon Rapides.

East African Airways Corporation, Nairobi. Serving Kenya, Tanganyika, Uganda, Zanzibar, Portuguese East Africa and South Africa. Fleet: ten DC-3s, two DH-89s and one Consul. Last year the company carried 93,427 passengers and flew 2,880,610 ton-miles.

Eastern Air Lines, Inc., New York City. Operates extensive network in Eastern States and services to Mexico City and Puerto Rico. E.A.L. carried over 4,750,000 passengers in 1952. Fleet: 29 Super Constellations (16 L.1049Cs and 13 L.1049s), 19 Constellation 749s, 60 Martin 4-0-4s, 12 DC-4s. Traffic for 1953: 4,771,167 passengers and 25m ton-miles.

East-West Airlines, Ltd., Tamworth, N.S.W. Local services with one DC-3 and two Hudsons.

El Al (Israel Airlines Ltd.), Tel Aviv. Transatlantic services via Greece, Italy, Switzerland, France and United Kingdom; European services to Turkey, Greece, Italy and Austria and African route to Nairobi and Johannesburg. Fleet: three Constellation 049s and four C-46s. In 1953 El Al carried 11,733 passengers and flew 10m ton-miles.

Ellis Airlines, Ketchikan, Alaska. Local services in Alaska with 7 Grumman G-21A amphibians, two Aeronca Sedan and one Cessna 180. Traffic in 1954: 52,465 passengers and 330,056 ton-miles.

Empresa Guatemalteca de Aviacion (Aviateca), Guatemala City. Domestic services with six DC-3s and one DC-4. The airline, known as Aviateca, carried 63,312 passengers in 1954.

Ethiopian Air Lines, Inc., Addis Ababa. (In association with T.W.A.) Domestic services and to Kenya, Aden, Sudan and Egypt. Fleet: two Convair 240s and eight DC-3s.

Far Eastern Airlines, Ltd., Osaka, Japan. New airline formed to operate domestic and regional services. Fleet: two Marathons, two Doves and three Auster Autocars. Last year the airline carried 5,762 passengers and 1,716 "sightseers."

Federation Air Service, Kuala Lumpur. (In association with Malayan Airways.) Local services with Beavers.

Fiji Airways, Suva. Local services with two D.H.89s and two Drovers.

FINNAIR (Aero O/Y), Helsinki. Domestic services and to Sweden, Denmark, Germany and France. Fleet: three Convair 340s and nine DC-3s.

Flugfelag Islands, H.F., Reykjavik. Domestic services and to United Kingdom, Norway and Denmark. Fleet: two DC-4s, four DC-3s, two Canso amphibians and one Goose. Traffic in 1954: 54,008 passengers and 1.8m ton-miles.

Flying Tiger Line — see Slick Airways.

Frontier Airlines, Inc., Denver. Local services in Colorado, Montana, Arizona, New Mexico, Utah and Wyoming with 12 DC-3s. Traffic last year: 145,579 passengers and 4,292,758 ton-miles.

Garuda Indonesian Airways, N.V., Djakarta. Services in Indonesia and to Bangkok, Singapore and Manila with a fleet of 15 DC-3s, 14 Herons, eight Convair 240s and eight Convair 340s. Last year Garuda carried 314,423 passengers and flew 20.5m ton-miles.

Gibraltar Airways, Ltd., Gibraltar. (In association with B.E.A.) Service Gibraltar-Tangier is operated by B.E.A. Pionairs, which carried 18,650 passengers on this route last year.

Grupo del Transportes, Lima. Domestic services in Peru with eight DC-3s, six D.H.89s, three Stinson, one Beechcraft, four PBY-5As and four Beavers.

Guinea Airways, Ltd., Adelaide. Local services with four DC-3s, two Super Autocars and one Fairchild Argus. Traffic in 1954: 86,843 passengers and 1,350 short tons of freight.

Gulf Aviation Co., Ltd., Bahrein. (Associate of B.O.A.C.) Operating Gulf services with four Doves.

Homists (Sino-Soviet Aviation Corporation), Alma Ata. Operating Alma Ata to Hami with Li-2s.

Hawaiian Airlines, Ltd., Honolulu. Inter-island services with five Convair 340s and ten DC-3s. Traffic in 1954: 387,887 passengers and 6,071,998 ton-miles.

Helicopter Air Service, Inc., Chicago. Mail operations in Chicago area with seven Bell 47s.

Hong Kong Airways, Ltd., Hong Kong. (Owned by Jardine, Matheson & Co., Ltd.) Operating Hong Kong-Formosa-Okinawa-Tokyo services with DC-4 chartered from Northwest Airlines. One Viscount 700D has been ordered for delivery in December 1957. Last year the airline carried 7,454 passengers and flew 570,000 ton-miles.

Iberia (Lineas Aereas Españolas), Madrid. European services, Spanish domestic services and to N. and S. America, Cuba, Mexico, Canary Is. and Spanish West Africa. Fleet: three L.1049Cs, six DC-4s, 16 DC-3s, one Bristol 170, one Ju52 and one Dragon. Last year Iberia carried 536,179 passengers.

Iceland Airways — see Flugfelag Islands.

Icelandic Airlines—see Loftleidir.

Indian Airlines Corporation, Calcutta. Responsible for the operation of Indian domestic services and services to Pakistan, Ceylon, Burma, Nepal and Afghanistan. Fleet: 71 DC-3s, 12 Vikings, three DC-4s, four Sentinels, one Beech D18S, one Safir, one Dove, one Avro XIX and one Beech D17S. Eight Herons are on order. In 1954 the Corporation carried 464,934 passengers and flew 31,695,437 ton-miles.

Iranian Airways Company, Teheran. Domestic routes and to India, Pakistan and Kuwait. Fleet: four DC-3s, two Doves and two Fairchilds.

Iraqi Airways, Baghdad. Domestic services and to Aleppo, Damascus and Cairo. Fleet: four Vikings and one Dove. Three Viscounts are due for delivery shortly. Last year the airline carried 39,737 passengers and flew 1.4m ton-miles.

Island Air Service, Port Clinton, Ohio. Local services with Ford Tri-motors.

Japan Air Lines, Tokyo. Domestic and trans-Pacific services. Fleet: six DC-4s, three DC-6Bs, two Herons, two Beech 18s and one Beech 11. On order two Comet 2s, one Heron and two DC-6Bs.

Japan Helicopter and Aeroplane Transports Co., Tokyo. Domestic services and powerline patrol with three Herons, two Doves and four Bell 47s. Two DC-3s ordered. The line carried 17,214 passengers last year.

Jugoslovenski Aer Transport, Belgrade. Domestic services and to Greece, Turkey, Austria, Germany and France, with 13 DC-3s and one Convair 340; two more Convair 340s are on order. Last year J.A.T. carried 80,079 passengers and flew 2.4m ton-miles.

Karhumäki Airways, Halli. Finnish domestic services and to Sweden with three DC-3s. The company carried 21,855 passengers and flew 400,000 ton-miles in 1954.

K.L.M. (Koninklijke Luchtvaart Maatschappij N.V.—Royal Dutch Air Lines), The Hague. European West Indies and New Guinea networks and routes from Europe to North and South America, South Africa, the Middle and Far East and Australia. Fleet: 12 L.1049C Super Constellations, ten Constellation 749As, six DC-6Bs, two DC-6As, six DC-6s, nine DC-4s, 16 DC-3s, 14 Convair 340s, seven Convair 240s, one D.H.89 and one Auster. On order are four L.1049Gs. Last year K.L.M. carried 682,926 passengers and flew 128m ton-miles.

Korean National Airlines, Pusan. Domestic services with DC-3s and DC-4.

Kuwait National Airways, Kuwait. Services in Persian Gulf area with three DC-3s. The airline carried 8,966 passengers in 1954.

L.A.I. see Linee Aeree Italiene.

L.A.V. see Linea Aeropostal Venezolana.

Lake Central Airlines, Indianapolis. Local services with seven DC-3s. The company is stated to be the only airline in the world wholly owned by its employees. Last year it carried 79,673 passengers and flew 1,146,751 ton-miles.

Leavens Bros. Air Services, Ltd., Toronto. Operating Leamington to Pelee Is. with three Cessna Cranes; fleet also includes 20 single-engined aircraft, used for training, spraying and dusting. Traffic for 1954: 2,653 passengers and 1,766 ton-miles.

Liberian International Airways, Robertsfield. Local services with three DC-3s and D.H.89s.

Lineas Aereas Costarricenses, S.A. San Jose (Subsidiary of P.A.W.A.). Domestic services and to Panama, Mexico, Cuba and U.S.A. Fleet: three DC-3s and four C-46s. On order: two Convair 340s. In 1954 the company carried 109,625 passengers and flew 3,936,527 ton-miles.

Lineo Aereo Taca de Venezuela, Caracas. Domestic services and to Colombia with DC-3s.

La Nica (Lineas Aereas de Nicaragua, S.A.), Managua. (Associate of P.A.W.A.) Local services with seven DC-3s and one Navion.

Lineo Aereo Nacional, Chile, Santiago. Domestic routes and to Argentina, Uruguay and Bolivia. Fleet: four Martin 2-O-2s, 14 DC-3s, 12 Doves, two Electras and one Bonanza.

Lineo Aeropostal Venezolano, Caracas. Domestic routes and to U.S.A., Cuba, Peru, Bermuda, Azores, Portugal, Spain and Italy. Fleet: two Super Constellations, four Constellations (two 049, two 749), 22 DC-3s, two Martin 2-O-2s, three C-46s. On order are one Super Constellation and three Viscounts. Last year Linea Aeropostal Venezolana carried 244,167 passengers and flew 50m ton-miles.

Lineas Aereas del Estado, Buenos Aires. Domestic routes. DC3s and Vikings.

Linee Aeree Italiane (S. p. A.), Rome. Operates domestic routes and to Israel, France, Spain, Switzerland, Greece, Turkey, Tunisia, Egypt and the U.S.A. Fleet: three DC-6s, 16 DC-3s, four Convair 240s and three DC-6Bs.

Lloyd Aero Boliviano (LAB), Cochabamba. Domestic services with 11 DC-3s and one Boeing B-17. On order: three DC-4s. Traffic for 1954: 144,005 passengers and 7m ton-miles.

Loftleidir, H.F., Reykjavik. Operating transatlantic services in association with Braathens, with one DC-4 Known also as Icelandic Airlines, the

DC-4 of Iberia, the Spanish international carrier.

The flying-boat

A SUMMING-UP

As a weapon of defence, as a means of economic air transport and as the natural medium for atomic propulsion, the modern flying-boat demands a place in this second half-century of powered flight.

The fifth and final announcement in the flying-boat series sponsored by Saunders-Roe appears overleaf. What is the summing-up in this case for the water-based aircraft?

During the year in which the campaign has been running many fresh facts have been displayed and many familiar fallacies have been exposed. It has been shown that many of the misconceptions have their root in experience of outdated aircraft.

It has been submitted that the large modern flying-boat can operate from natural stretches of water such as the Solent . . . that it is able to operate in almost any weather . . . that with jet or prop-jet engines it is as fast as a comparable land-plane — and has a longer range.

It has been pointed out that three long-range flying-boats such as the *Princess*, operating without pre-arranged facilities and able to accept re-routing at short notice, could transport in a given period as many men as nine troopships. Further, it has been asserted that the ocean-patrol flying-boat designed today is able to operate with flexibility and independence in open-ocean conditions.

There has been a discussion of the future and the coming of atomic power for aircraft. The great weight of power plant and shielding and the high wing loading at landing (due to negligible fuel consumption) both support the proposition that atomic aircraft will have to be flying-boats.

In the United States where the significance of water-based aircraft is better appreciated, flying-boats are in active production. The conclusion, surely, is that with its present performance and future possibilities, the flying-boat continues to demand the attention of all in Britain who are concerned with defence and economic air transport. We have at present great resources of experience, knowledge and technical ability for the design of flying-boats. We must either use or eventually lose these assets.

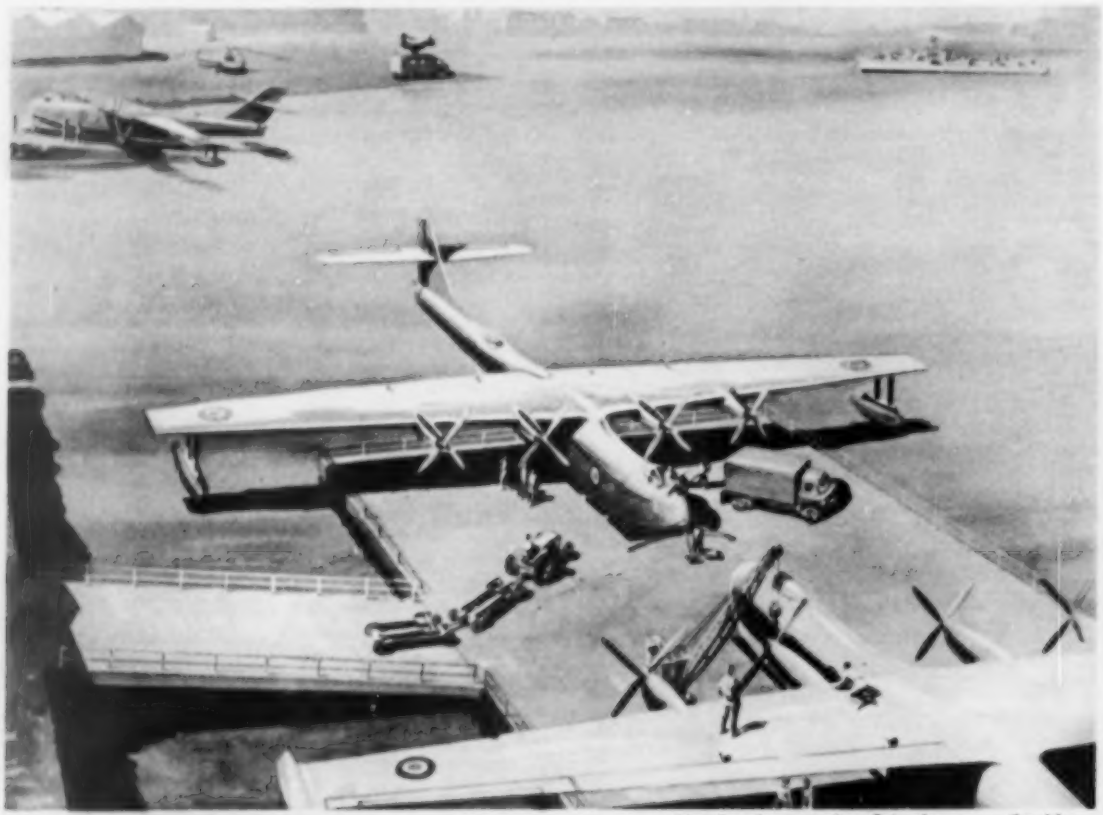
AS A WEAPON OF DEFENCE,
AS A MEANS OF
ECONOMIC AIR TRANSPORT
AND AS A NATURAL MEDIUM FOR
ATOMIC PROPULSION,
THE MODERN FLYING-BOAT
DEMANDS A PLACE
IN THIS SECOND HALF-CENTURY
OF POWERED FLIGHT

The flying-boat

FIXED AND MOBILE BASE OPERATION

The great advance in the efficiency and performance of the flying-boat in recent years has been accompanied by important progress in the development of operational facilities and aids. Thus the flying-boat is more than ever the most adaptable, versatile and economic of all aircraft for long-range transport and general military duties.

Independent of costly and vulnerable prepared runways, the flying-boat has the key feature of flexibility — the ability to perform either from a mobile base in a remote part of the world or from a fixed base. Each of these operating conditions is met in its own way.



Handling large modern flying-boats at a fixed base.

THE FIXED BASE

The permanent base, always less costly than the comparable landplane layout, can now have every feature for easy, rapid and economic operation. The pontoon docks can accommodate any size of aircraft at present contemplated, and reverse thrust and water rudders enable the aircraft to manœuvre with precision under their own power. Shore-mounted radar, radio communication and all other modern navigational aids are of course available.

Landing stores and setting up inflatable pontoons at a mobile flying-boat base.

THE MOBILE BASE

Here the aim is for the flying-boats to be — initially, at least — entirely self-sufficient. They carry their own provisions, their own maintenance crews and equipment and, above all, their own inflatable pontoons. These are of unit construction — for easy assembly, dismantling and transportation — and can be built up into floating platforms of any shape or size. Almost all maintenance can be carried out afloat. The aircraft's engine cowlings convert to built-in maintenance platforms and underwater inspection and repair can be carried out by members of the crew trained as frogmen.

An impression of the mobile base only 8 hours after arrival of the first flying-boat.

JET Provost

** Slow approach and stalling speeds giving the pupil pilot confidence, are coupled with an endurance of over 2 hours at sea level giving an adequate training period at circuit height.*

** The wide performance range of the "Jet Provost" is emphasised when this is compared with an endurance of over 3 hours at 20,000 ft. (6100 metres), a maximum speed of 285 kts. (528 k.p.h.) and a service ceiling of nearly 30,000 ft. (9150 metres.)*

** The power unit is an Armstrong Siddeley long life "Viper" turbo-jet.*

HUNTING PERCIVAL AIRCRAFT LTD

A Hunting Group Company

LUTON, BEDFORDSHIRE, ENGLAND AND AT TORONTO, CANADA

AP120-304

WORLD AIRLINE DIRECTORY . . .

company carried 11,000 passengers last year.

Loide Aero Nacional, S.A., Rio de Janeiro. Domestic services with 15 C-46s and three DC-4s; traffic figures for last year are 65,515 passengers and 9.4m ton-miles.

Los Angeles Airways, Inc., Los Angeles. Helicopter mail services in Los Angeles area with three S-51s and three S-55s.

LOT (Polskie Linie Lotnicze), Warsaw. Domestic routes and to Eastern Europe and Belgium, France, Denmark and Sweden. Il-12s and DC-3s. Total number of passengers carried in 1953 was 112,900.

Middle East Airlines Co., Beirut. (Associated with P.A.W.A.) Services in Near East with seven DC-3s. Traffic for 1954: 48,450 passengers and 2,801,394 ton-miles.

Misrair S.A.E., Cairo. Domestic services and to Sudan, Aden, Saudi Arabia, Libya, Tunisia, Syria, Iraq, Lebanon, and Persian Gulf. Fleet: Seven Vikings, three Languedocs and one Beechcraft; on order, three Viscounts. Traffic in 1954: 64,539 passengers and 3.1m ton-miles.

Mohawk Airlines, Inc., Ithaca, N.Y. Local services with 11 DC-3s; three Convair 240s will be introduced on July 1st. Last year Mohawk carried 222,148 passengers and flew 3,981,627 ton-miles.

National Airlines, Inc., Miami. Operating network through the Eastern States from New York south to Miami and Havana. Services operate west to New Orleans. Also Miami area helicopter services. Fleet: four DC-7s, eight DC-6Bs, four DC-6s, 12 Convair 340s, ten Lodestars and one S-55. Last year National carried 1,074,704 passengers and flew 84,640,128 ton-miles.

Navegacao Aerea Brasileira (N.A.B.), Rio de Janeiro. Local services with DC-3s.

New York Airways, Inc., New York. Local passenger, mail and express services with five S-55s. Last year N.Y.A. carried 8,180 passengers and flew 53,314 ton-miles.

New Zealand National Airways Corporation, Wellington. Domestic routes and to Norfolk Island. Fleet: 23 DC-3s, four Herons, six Rapides and one Fox Moth. Last year N.Z.N.A.C. carried 337,485 passengers and flew 10,343,642 long ton-miles.

North Central Airlines, Inc., Minneapolis. Local services with 18 DC-3s. Last year the company carried 283,556 passengers and flew 5,282,516 ton-miles.

Northeast Airlines, Inc., Boston. Serving New York, Montreal and New England. Fleet: 12 Douglas DC-3s and seven Convair 240s; no orders, but the company is "shopping for larger equipment." Last year Northeast carried 523,489 passengers and flew 10,158,041 ton-miles.

Northern Consolidated Airlines, Inc., Anchorage. Local services with three DC-3s, three Norsemen and 15 Cessna T.50 Bushmasters. Traffic in 1954: 11,451 passengers and 923,336 ton-miles.

Northern Wings, Ltd., Seven Islands. Local services with Norsemen, Anson, Canso and Beechcraft.

Northwest Airlines, Inc., St. Paul, Minnesota. Transcontinental U.S. network and to Honolulu, Alaska, Japan, Korea, Formosa, Hongkong and Manila. Fleet: ten Stratocruisers, seven DC-6Bs, 19 DC-4s and seven DC-3s. The airline, which operates as Northwest Orient Airlines, is now taking delivery of four L.1049G Super Constellations. Last year it carried 1,200,000 passengers and flew 84,525,111 ton-miles.

Orient Airways, Ltd., Karachi. Domestic services and to India and Burma. Fleet: two Convair 240s and 11 DC-3s. In 1954 the company carried 66,636 passengers and flew 2,952,525 ton-miles.

Ostermans Aero A.B., Stockholm. Scheduled mail services in Stockholm archipelago in winter with seven Bell 47s (three more are on order), one S-55 and four Seabees. Hours flown by the helicopters in 1954 totalled 4,260.

Ozark Air Lines, Inc., St. Louis, Mo. Local services in Arkansas, Indiana, Iowa, Oklahoma, Kentucky, Kansas, Missouri, Illinois and Tennessee. Fleet: 13 DC-3s.

Pacific Northern Airlines, Seattle. Operating in Alaska and between U.S.A. and Alaska. Fleet: four DC-3s and five DC-4s.

Pacific Western Airlines, Ltd., Vancouver. Services in British Columbia with two Mallards, six Beavers, four Norseman, two Fairchild 71s, two Junkers W33, three Cessna 180s, one Cessna 170, one Cessna 120, one Widgeon, one Beechcraft A18A and two Beechcraft F17s. In 1954 the company carried 29,598 passengers and flew 16,686 ton-miles.

Pakistan International Airlines, Karachi. Services to London and Delhi with three L.1049C Super Constellations. The Airline began operations in June 1954, and flew 2,288,089 ton-miles and carried 11,902 passengers in that year.

Panair do Brasil, Rio de Janeiro. Domestic network of 60,000 miles and transatlantic services. Fleet: 14 DC-3s, 11 Constellation O49s and five Canso amphibians. Comets are on order. Last year Panair carried 360,000 passengers and flew 27,878,232 ton-miles.

Pan American-Grace Airways, Inc., New York City. (Associate of Pan American World Airways.) Route network in South America extending north to Miami. Fleet: four Douglas DC-6Bs, four DC-6s, three DC-4s and six DC-3s. On order: five Douglas DC-7s. In 1954 the company carried 133,848 passengers and flew 19,864,118 ton-miles.

Pan American World Airways, Inc., New York City. Operating a worldwide network with over 60,000 miles of unduplicated routes. Fleet: 27 Stratocruisers, 45 DC-6Bs, 27 DC-4s, seven DC-3s, eight Constellations and 13 Convair 240s. On order: seven DC-7Bs and three Comet 3s. In 1953 (no figures for last year available) P.A.A. carried 1,643,633 passengers and flew 250m ton-miles.

Philippine Air Lines, Inc., Manila. Domestic routes and to Hongkong and Bangkok with DC-3s and Convair 340s.

Piedmont Airlines, Winston Salem, N. Carolina. Local services in N. and S. Carolina, Kentucky, Ohio, Tennessee, Virginia and West Virginia. Fleet: 15 DC-3s. Last year Piedmont carried 308,893 passengers and flew 6,339,040 ton-miles.

Pioneer Air Lines, Inc., Dallas. Local services in Texas and New Mexico with 10 DC-3s.

Primeras Lineas Uruguayas de Navigaçion Aerea, Montevideo. Domestic services with DC-3s and Herons.

Qantas Empire Airways, Ltd., Sydney. Australia's international airline operating domestic and Pacific regional services in addition to its Wallaby service to South Africa and routes to the Philippines, Hongkong and Japan. In 1954 Q.E.A. took over the operation of the B.C.P.A. trans-Pacific route to Vancouver. Fleet: ten L.1049C Super Constellations, four Constellation 749As, five DC-4s, eight DC-3s, three Sandringhams, two Catalinas, three Beavers and one Drover; on order, one Beaver. Last year Qantas carried 118,513 passengers and flew 46,454,694 ton-miles.

Quebecair, Inc., Rimouski. Local services with four DC-3s, three Beavers and one Beechcraft D18. Last year Quebecair carried 105,635 passengers and flew 52,547 ton-miles.

Queen Charlotte Airlines, Ltd., Vancouver. Services in British Columbia with two DC-3s, two Cansos, two Stranraer and five Norseman.

Queensland Airlines (Pty.), Ltd., Brisbane. Operating services in N.S.W. and Queensland with three DC-3s. Handley Page Heralds are on order. Last year the company carried 52,591 passengers.

Real (Real, S.A., Transportes Aereos), Sao Paulo. Domestic services and to Paraguay and Uruguay with 32 DC-3s; on order, eight Convair 340s.

Reeve Aleutian Airways, Inc., Anchorage. Services to the Alaska Peninsula and the Aleutian and Pribilof Islands, with three DC-3s, two Sikorsky S-43s and one Grumman Goose. Last year Reeve carried 2,968 passengers and flew 647,792 ton-miles.

Riddle Airlines, Inc., Miami. Freight-only services between New York, Miami and Puerto Rico with nine C-46s (one leased). Riddle flew 14,856,425 ton-miles last year.

Sabena (Société Anonyme Belge d'Exploitation de la Navigation Aérienne—Belgian Airlines), Brussels. Operating European and Congo networks and services from Belgium to the U.S.A., Libya, Morocco, Nigeria, Belgian Congo, South Africa, Egypt, Sudan and Uganda. Also operating Europ can helicopter services. Fleet: five DC-6s, seven DC-6Bs, two DC-6As, seven DC-4s, 19 DC-3s, nine C-47s, four Convair 240s and six S-55s. On order, one DC-6B. In 1954 the company carried 395,000 passengers and flew 51.6m ton-miles.

Saskatchewan Government Airways, Prince Albert. Local services. Fleet: one DC-3, three Annons, six Norseman, four Beavers, one Stinson, four Cessna 140s and three Cessna 180s.

SATA (Sociedade Acoriana de Transportes Aéreos, Lda.), Ponta Delgada. Local routes in Azores with Dovers.

Saudi Arabian Airlines, Jeddah. Operates network of Near East routes with 13 DC-3s, five DC-4s and five Bristol 170s.

S.A. Viacao Aerea Gaucha (Savag), Rio Grande do Sul, Brazil. Domestic routes with DC-3s.

Scandinavian Airlines System, Stockholm. Comprises Danish, Norwegian and Swedish Air Lines. Operates domestic services in Denmark, Norway and Sweden, a European network and long-distance routes to North and South America, South Africa and the Far East. S.A.S. is pioneering Polar routes. Fleet: 14 DC-6Bs, 12 DC-6s, 10 DC-3s, four DC-4s, eight Scandias and two Ju 52s. Eight DC-7C Seven Seas have been ordered, for delivery in 1956. In the year ended September 30th, 1954, S.A.S. carried 709,000 passengers and flew about 70m ton-miles.

Servicio Aereo de Honduras, S.A. (SAHSA), Tegucigalpa. (Associate of P.A.W.A.) Domestic services with seven DC-3s.

Servicio de Transportes Aéreos, S. Tomé, Portuguese East Africa. Local

(Above) Lufthansa Convair on a pre-delivery test flight.

(Below) Panagra DC-6 at Ezeiza Airport, Buenos Aires.

Formerly used by B.C.P.A., this DC-6 now wears the colours of Tasman Empire Airways.

WORLD AIRLINE DIRECTORY . . .

services with two Rapides, one Autocar and one Super Cruiser.

Serviços Aereos Cruzeiro do Sul, Ltda., Rio de Janeiro. Domestic services and to Argentina. Fleet: 35 DC-3s, six AT-11s and one Convair 340. On order: three Convair 340s.

SKOGA (Airline of People's Democratic China), Pekin. Chinese domestic services and Pe-tin-Moscow in conjunction with Aeroflot, using Li-2s.

Société Aérienne de Transports Guyanne-Antilles, Cayenne. Local services with one Monospar, one Rapide, one Sentinel and one Bell 47; on order, one SCAN 30 and one Rapide. Passengers in 1954: 1,167.

Société de Transports Aériens en Extrême Orient, Saigon. Local services with four DC-3s and four Bretagnes. In 1954 the company carried 90,600 passengers.

SOKAO (Soviet-North Korean Airline), Peng-Yang. Operates part of Peng-Yang to Moscow route in collaboration with Aeroflot and Skoga. Believed to operate 11 12s.

SOBELAIR (Société Belge de Transports par Air, S.A.). Frequent charter services from Belgium to Congo with one DC-4 and three DC-3s. Traffic last year: 3,155 passengers and 1.5m ton-miles.

South African Airways, Johannesburg. Operating services in the Union and to the Rhodesias, Kenya, Portuguese East Africa, Uganda, Sudan, Egypt, Greece, Italy, Germany and United Kingdom. Fleet: four Lockheed Constellations, seven Douglas DC-4s, five DC-3s and ten Lockheed Ladestars. On order: three DC-7Bs. In 1954 the company carried 217,809 passengers and flew 25,038,277 ton-miles.

Southern Airways, Inc., Atlanta. Local services in Southern States with ten DC-3s. Last year Southern Airways carried 133,544 passengers and flew 2,319,873 ton-miles.

Southwest Airways Company, South San Francisco. Local services in California and to Oregon with four Martin 2-O-2s and nine DC-3s. Traffic for 1954: 203,814 passengers and 3,842,551 ton-miles.

Sudan Airways, Khartoum. Domestic routes with four DC-3s and four Doves; on order, one DC-3. Traffic last year: 21,580 passengers and 939,616 ton-miles.

Swissair (Swiss Air Transport Co.), Zurich. Operating European services and to the Near East, North and South America. Fleet: six DC-6Bs, three DC-4s, 13 DC-3s, seven Convair 240s; on order, two DC-7C Seven Seas for delivery in October/November 1956. Last year Swissair carried 544,838 passengers and flew 52m ton-miles.

Syrian Airways Company, Damascus. Domestic services and to Saudi Arabia and Kuwait with four DC-3s, one DC-4 and one Languedoc.

TABSO (Bulgarski Vnduszni Linii), Sofia. Domestic routes and to Hungary and Czechoslovakia with Li 2s.

T.A.C. (Empresa de Transportes Aéreos Catarinense, S.A.), Florianopolis. Brazilian domestic services with DC-3s.

Taca de Costa Rica, S.A., San Jose. Domestic services with DC-3s.

Taca de Honduras, Tegucigalpa. Domestic services with DC-3s.

Taca International Airlines, S.A. San Salvador. Serving Costa Rica, El Salvador, Guatemala, Honduras, British Honduras, Mexico and Nicaragua with DC-4s.

TAE (National Greek Airlines), Athens. Domestic services and to United Kingdom, France, Italy, Turkey, Yugoslavia and Egypt with one DC-4 and 14 DC-3s. Traffic for 1954: 119,895 passengers and 3m ton-miles.

T.A.I. (Compagnie des Transports Aériens Intercontinentaux), Paris. Operating services from France to French Indo-China, Madagascar and French West Africa. Fleet: three DC-6Bs and three DC-4s. On order: two DC-6Bs for delivery this year. Last year T.A.I. carried 43,728 passengers and flew 20m ton-miles.

TAP (Transportes Aéreos Portugueses), Lisbon. Domestic Services and to Spain, United Kingdom, West Africa, Morocco and France with three DC-4s, six DC-3s and one Beechcraft. On order, three Super Constellations. Last year T.A.P. carried 27,310 passengers and flew 7.2m ton-miles.

TARS (Societate Romano-Sovietica de Transporturi Aeriene), Bucharist. Domestic services with Li 2s.

Tasman Empire Airways, Ltd., Auckland. Routes linking Australia and New Zealand and from New Zealand to Fiji and Chatham Island. Fleet: three DC-6s and two Solent flying-boats. In 1954 the airline carried 41,500 passengers; ton-mileage was in the region of 6.5m.

Thai Airways Co., Ltd., Bangkok. Domestic services and to India, Burma, Hong Kong, Formosa, Japan, Indo-China and Malaya with five DC-3s, two DC-4s, one Canso and one Fairchild. On order, two Super Constellations, for delivery in July. Last year Thai Airways carried 50,074 passengers and flew 3.2m. ton-miles.

TPA Alaska Airlines, Honolulu. Operates inter-island routes with six DC-3s. Traffic in 1954: 173,439 passengers and 1,815,789 ton-miles.

Transair Sweden, A.B., Stockholm. Stockholm-Visby route and newspaper flights with two DC-3s and three Consuls. On order, one DC-3. Last year the airline carried 19,313 passengers.

Trans-Australia Airlines, Melbourne. Operating an extensive Australian network with over 25,000 miles of routes. Fleet: five Convair 240s, three DC-4s, 24 DC-3s, three D.H. Drovers and four D.H. Dragons. The airline has ordered six Viscounts, of which four had been delivered and introduced to service at the time of writing. Last year T.A.A. carried 669,554 passengers and flew 9,421,795 freight ton-miles.

Trans-Canada Air Lines, Montreal. Operating extensive Canadian network including transcontinental routes and routes to U.S.A., Bermuda, Barbados, Trinidad, Bahamas, Jamaica, Mexico and Europe. Fleet: eight Super Constellations, 22 Canadair Four North Stars, 27 DC-3s and three Bristol 170s. On order are 22 Viscounts of which four had been delivered at the time of writing. Last year T.C.A. carried 6,429,000 passengers.

Trans Mar de Cortes, Guaymas, Services in Mexico with three DC-3s.

Transportes Aereos de Jalisco, S.A., Guadalajara. Services in Mexico with two DC-3s, one Cessna and one Boeing.

Transportes Aéreos da Gabon, Gabon, F.E.A. Local services with three Rapides, three Cessna 170s and one Autocrat. Passengers in 1954: 4,093.

Transportes Aereos Nacional Ltda., Rio de Janeiro. Domestic services with DC-3s.

Transportes Aereos Nacionales, S.A., Tegucigalpa. Services from Honduras to U.S.A., Cuba, Nicaragua and El Salvador, with two C-46s.

Transportes Aereos Salvador, Salvador. Local Brazilian services with three Bonanzas and a Heron. Last year the company carried 14,676 passengers.

Trans-Texas Airways, Houston. Local services in Texas with 16 DC-3s.

Trans World Airlines, Inc., Kansas City. Extensive U.S. network including transcontinental routes and world network to Europe, Middle and Far East. Fleet: ten L.1049 Super Constellations, 27 L.749A Constellations, 12 L.749 Constellations, 32 L.049 Constellations, 40 Martin 4-0-4s, 11 Martin 2-0-2s, 11 DC-4s and six DC-3s. On order: 20 L.1049G Super Constellations. In 1954 T.W.A. carried 3,593,910 passengers and flew 373.1m ton-miles.

Tunis Air (Société Tunisienne de l'Air), Tunis. Services in North Africa and to France with three DC-3s, one DC4 and one Languedoc.

U.A.T. (Union Aéromaritime de Transport), Paris. Operating services from France to Libya, Cameroons, French Equatorial Africa, South Africa, French Guinea and French Ivory Coast. Also African local services. Fleet: four DC-6s, two Norstlas, one DC-4 and nine Herons. Last year U.A.T. carried 76,783 passengers.

Union or Burma Airways (UBA), Rangoon. Domestic services and to Thailand, Malaya and India with 12 DC-3s, three Doves, two Marathons and a Catalina. The Burmese Government has approved a proposed order for three Viscounts. Last year U.B.A. carried 131,705 passengers and flew 1,323,860 ton-miles.

United Air Lines, Inc., Chicago. Operating transcontinental network and to Honolulu and Vancouver. Fleet: 25 DC-7s, 63 DC-6s and DC-6Bs, 55 Convair 340s, 20 DC-4s and 18 DC-3s. On order, and due for delivery this year, are two DC-7s, 10 DC-6Bs and five DC-6As. Traffic for last year: 4,777,000 passengers and 67,923,000 cargo ton-miles.

Urabe, Medellin and Central Airways, Inc. (UMCA), Medellin Domestic services with Convair 240.

VARIG (S.A. Empresa de Viação Aérea Rio Grandense), Porto Alegre. Domestic services in Brazil and to Uruguay and Argentina with two Lockheed Electras, 23 DC-3s, 14 C-46s and five Convair 240s. In 1954 the company carried 405,058 passengers and flew 11.5m ton-miles.

VASP (Viação Aérea Sao Paulo, S.A.), Sao Paulo. Domestic services in Brazil with 16 DC-3s and five Scandias. On order: four Scandias. In 1954 VASP carried 252,263 passengers.

Vestlandske Luftfartselskap S.A. (West-Norway Airlines), Bergen. Operates West-Norway services with two Sealands and three Seabees. In 1954 the company carried 8,870 passengers and flew 106,000 ton-miles.

West African Airways Corporation, Lagos. Domestic services and to neighbouring countries with four Bristol 170s and five Doves. On order: three Heron 2s. In 1954 the company carried 68,415 passengers and flew 2,074,515 ton-miles.

West Coast Airlines, Seattle. Local services with 12 DC-3s.

Western Air Lines, Inc., Los Angeles. Network of services in Western States and to Edmonton, Minneapolis-St. Paul and Rochester. Fleet: eight Douglas DC-6Bs, six DC-4s, nine DC-3s and nine Convair 240s.

Wheeler Airlines, Ltd., St. Jovite. Local services in Quebec Province with one Anson V, three Norsemen, one Beaver, one Canso, two Cessna 195s and seven Stearman. In 1954 the company carried 5,199 passengers.

Widerøe's Flyveselskap og Polarfly A.S., Oslo. Operating Northern Norway routes, some on behalf of S.A.S., with Otter and Norseman.

Wien Alaska Airlines Inc., Fairbanks. Domestic services with two C-46s, three DC-3s, six Noonduyns, three Cessna 195s, eight Cessna 170s and one Cessna 180.

(Above) Aeromaritime DC-6 at Casablanca and (below) a Scandinavian DC-6B at London Airport.

BRITAIN'S INDEPENDENT OPERATORS

A Concise Directory to the Private Scheduled and Charter Airlines

Air Charter, Ltd.—Channel Air Bridge service for vehicles and supplementary freight, Southend to Calais. Trooping to West Africa and the Canal Zone. Charter (passengers and freight), and pleasure flights. Head office, 15 Great Cumberland Place, London, W.1. Main bases, Southend and Stansted, Essex. Executives: Capt. E. N. Jennings (chief pilot and operations manager), G. W. Forster (commercial manager), A. F. Nickalls (chief accountant). Fleet: seven Yorks, three Tudors, three Bristol 170s Mk 31, one DC-4. On order, two Bristol 170s Mk 32, two DC-4s. In 1954 Air Charter carried 22,935 passengers and 26,430 short tons of freight, and flew 2,239,039 revenue miles.

Air Couriers (Transport) Ltd.—Operators of charter services. Head office, Croydon Airport, Surrey. Main base, Croydon. Executives: C. P. L. Godsal, F. W. Griffith (directors) and K. J. Kelly (chief engineer). Fleet: two Rapides and one Gemini.

Air Kruise, Ltd. (Trans-Channel Airways).—Scheduled passenger and charter services. Head office, Lympne Airport, near Hythe, Kent. Main bases, Lympne and Lydd Airport (Ferryfield). Scheduled routes: Lydd - Le Touquet and Lydd - Ostend. Inclusive tour routes, Lydd - Basle, Lydd - Geneva, Lydd - Turin, Lydd - Venice, Lydd - Salzburg, Lydd - Copenhagen, Lydd - Lyon, Manchester - Geneva, Manchester - Ostend, Birmingham - Basle and Birmingham - Ostend. Fleet: four Rapides and four Dakotas. In 1954 Air Kruise carried 25,000 passengers.

Air Navigation and Trading Co., Ltd.—Contract charter services and flying training. Head office, Squires Gate Airport, Blackpool. Main bases, Blackpool and Middleton. Executives: R. L. Whyham (chairman and chief engineer), G. C. S. Whyham (operations manager), Capt. T. J. Franks (chief pilot), E. Minshaw (C.F.I.), and W. R. MacPherson (chief inspector). Fleet: two Avro 19s, four Ansons, two Rapides, two Dragons, six Austers, four Tiger Moths and three Proctors. On order: one Drover or Otter.

Airviews, Ltd.—Scheduled passenger services, charter and pleasure flights and aerial photography. Head office, Manchester Airport, Wythenshawe, Manchester. Main base, Manchester Airport. Executives: J. B. Martin and H. A. McCarthy. Scheduled routes: Manchester - Southampton - Isle of Wight. Fleet: Rapide, Auster, Cygnet and Tiger Moth.

Airways Union, Ltd.—The company controls subsidiaries engaged in the manufacture and repair of aircraft and components and the operation of airports, flying clubs, charter services and flying schools. Head office, The Airport, Weston-super-Mare, Somerset. Main bases, Weston-super-Mare, Exeter and Plymouth. Executives: R. King-Farlow (chairman), S. J. Cox (secretary and general manager), F. G. Jeans, W. R. Parkhouse and R. J. B. Pearse. Fleet: one Gemini, three Austers, five Tiger Moths and one Miles Messenger. In 1954 Airways Union carried 3,730 passengers.

Airwork, Ltd.—Operators of scheduled passenger and freight services, long-term contract flying and trooping services. Head office, 15, Chesterfield Street, London, W.1. Main bases, Blackbushe and London Airport. Executives: M. D. N. Wyatt (chairman and joint managing director), Sir Archibald Hope (joint managing director), R. Loudon Cumming (director and secretary), D. R. Seton-Winton (sales director), I. J. Rees (technical manager), A. G. Miller (general manager, commercial), K. R. Sangster (commercial manager), L. A. Lafoe (manager, overseas division), L. R. Castlemaine (general sales manager). Scheduled routes: Colonial coach services from London to Nairobi, Salisbury and Accra with intermediate traffic on each route. Freight services from Milan, Zurich, Basle, Frankfurt and London to New York and Montreal, *via* Manchester and Glasgow. Fleet: four Hermes, eight Vikings and three Dakotas. Aircraft ordered: three DC-6As and three Viscount 700Ds.

Aquila Airways, Ltd.—Scheduled flying-boat passenger services, and charter and trooping work. Head office, 1, Great Cumberland Place, London, W.1. Main base, Southampton. Executives: B. T. Aikman (managing director) and R. Clark (operations manager). Scheduled routes: Southampton - Lisbon - Madeira - Canary Islands, Southampton - Marseilles - Capri and Southampton - Genoa and Santa Margherita. All-freight service from Southampton to Perth, Australia has been applied for. Fleet: five Short Solents and two Short Hythes. In 1954 Aquila Airways carried about 8,000 passengers.

Autair, Ltd.—All classes of charter work—survey, photography, publicity, freight and passenger services. Head office, 109 Jermyn Street, London, S.W.1. Main bases, Croydon and Dusseldorf. Executives: W. H. Armstrong and R. Myhill, M. Macdonald (commercial manager). Fleet: three Sikorsky S-51s. On order, Bell 47Gs.

B.K.S. Air Transport, Ltd.—Scheduled passenger and freight services, charter and trooping work and daily newspaper service from Germany. Head office, 1 Marylebone High Street, London, W.1. Main bases, Southend, Newcastle and Leeds. Executives: J. W. Barnby, T. D. Keegan and C. J. Stevens. Scheduled routes: Newcastle and/or Leeds to Jersey, Isle of Man, Isle of Wight and Ostend, Southend to Leeds and Leeds to Belfast. Inclusive tours, Southend - Corsica - Southend, Southend - Majorca - Southend, Southend - Corsica - Majorca - Southend, Newcastle and/or Leeds - Basle - Leeds - Newcastle, Newcastle - Lourdes - Newcastle, Leeds - Lourdes - Leeds, Newcastle and/or Leeds - Paris - Leeds - Newcastle. Fleet: five Dakotas and three Vikings. In 1954 B.K.S. Air Transport carried 17,696 passengers and flew 1,612,510 revenue-freight-ton miles.

Britavia, Ltd.—Operators of War Office trooping contracts, charter flying. Head office, 1 Great Cumberland Place, London, W.1. Main base, Blackbushe. Executives: Eoin C. Mekie (chairman), B. Lamplugh (operations manager). Route: all-

A notable event in 1954 was the opening of Silver City Airways' private air-ferry terminal at Ferryfield, near Lydd, Kent. Three of the Bristol 170 fleet is visible in this view of the airport, which is situated on flat ground near the coast at Dungeness.

"Flight" photographs

The Viking has been turned into a useful short-haul freighter by the incorporation of a large cargo door, measuring 68in×63in, designed and fitted by Eagle Aircraft Services, Ltd. Britain's first transatlantic air-cargo service was inaugurated on March 1st by Airwork, Ltd., initially with leased American DC-4s. The service will later be operated with Airwork's own DC-6As.

BRITAIN'S INDEPENDENT OPERATORS . . .

freight service to Perth, Australia, applied for. Fleet: six Hermes IVs.

Cambrian Air Service, Ltd.—Scheduled passenger services, charter and army co-operation flights. Head office, Rhoose Airport, near Barry, Glamorgan. Main base, Cardiff (Rhoose). Executives: J. H. Watts (chairman), W/C. L. B. Elwin and W. W. Stanley (joint managing directors), B. J. T. Callan (commercial and operations manager), G. A. Perrott (chief pilot) and L. E. Moore (chief engineer). Scheduled routes: Liverpool to Cardiff - Bristol - Jersey - Guernsey; Cardiff to Paris - Jersey - Guernsey - Haverfordwest - Liverpool - Southampton; Bristol to Paris - Jersey - Guernsey - Liverpool - Southampton; Cheltenham/Gloucester to Paris - Jersey - Guernsey; Southampton to Paris - Bristol - Cardiff. Additional routes approved by the M.T.C.A. for future operation: Haverfordwest - Swansea - Cardiff - London and Haverfordwest - Dublin (provisional approval). Fleet: two Dakotas, three Doves, two Rapides, one Proctor and one Auster. In 1954 Cambrian Air Services carried 24,973 passengers and flew 455,000 revenue ton-miles.

Channel Airways (East Anglian Flying Services, Ltd.).—Scheduled passenger and charter services. Head office, Southend Airport, Southend. Main bases, Southend, Ipswich and Shoreham. Executives: S/L. R. J. Jones (managing director), A. E. Hugo Parsons (director-operations) and D. G. Burgess (chief pilot). Scheduled routes: Ipswich - Southend - Rochester - Shoreham - Paris; Ipswich - Southend - Rochester - Shoreham - Channel Islands; Ipswich - Southend - Ostend; Ipswich - Southend - Le Touquet; Shoreham - Le Touquet; Portsmouth - Shoreham - Isle of Wight; and Ipswich - Southend - Calais (as from June 1st). Fleet: three Doves, three Rapides, two Proctors, two Tiger Moths and two Austers. In 1954 Channel Airways carried over 3,000 passengers.

Dan-Air Services, Ltd.—Passenger and freight charter, trooping and inclusive tour services. Head office, 36/38, New Broad Street, London, E.C.2. Main operating base, Blackbushe; maintenance and engineering base, Lasham Airfield, Alton, Hants. Executives: F. E. F. Newman, J. W. Davies, E. O. Wallis (directors), A. F. Austin (secretary), Capt. F. R. Garside (chief pilot), A. D. Heard (traffic engineer), H. A. Scroggs (chief engineer). Inclusive tour route: Blackbushe—Calvi (Corsica). Fleet: one York, two Dakotas.

Derby Aviation, Ltd. (incorporating Wolverhampton Aviation, Ltd.).—Scheduled and charter passenger services; freight-carrying; flying schools. Head office, 78 Buckingham Gate, London, S.W.1. Main bases, Derby, Wolverhampton and Elstree. Executives: G/C. C. A. B. Wilcock (chairman), J. Harben (deputy chairman), W/C. H. A. Roxburgh (managing director), E. W. Phillips, L. E. T. Barley, R. R. Paine, A. C. Felts (secretary), K. W. Felts (chief engineer), E. W. A. Lines (chief pilot). Scheduled routes: Derby - Tollerton - Wolverhampton - Elmdon - Jersey. Fleet: two Dakotas, two Rapides, one Gemini; light aircraft for training and photography. In 1954 Derby Aviation carried 1,207 passengers.

Don Everall (Aviation) Ltd.—Operators of scheduled services, charter and aerial photography, advertising and ambulance services. Head office, Elmdon Airport, Birmingham. Main base, Elmdon. Executives: D. Everall and C. Everall (directors), A. D. Atkinson (operations manager) and E. Holden (chief engineer). Scheduled routes: Birmingham - Leicester East - Coventry - Jersey - Guernsey; Coventry - Wolverhampton - Ronaldsway; Birmingham - Weston-super-Mare - Cardiff; Birmingham - Isle of Wight (awaiting approval). Fleet: three Rapides, one Messenger and one Auster. In 1954 Don Everall carried 5,765 passengers.

Eagle Aviation, Ltd.—Operators of scheduled passenger services, charter and trooping flights. Head office, 29 Clarges Street, London, W.1. Main base, Blackbushe. Executives: H. Bamberg (managing director), A. Bamberg, N. Ashton Hill, P. C. F. Morgan and Maj. Gen. Greaves (directors), G. W. Pitt (charter division), W. H. Dixon (airline division) and P. Dean (sales division). Routes: scheduled services from London to Luxembourg and Innsbruck; London to Belgrade; Manchester to Munich and Vienna; from Birmingham to Munich and Vienna. Inclusive tour services from London to Pisa, Turin, Valencia, Palma-Minorca and Nice-Corsica. Fleet: ten Vikings and two Dakotas.

Fisons Pest Control, Ltd.—Operators of passenger and freight services, charter, agricultural spraying and locust control. Head office, Bourn, Cambridge. Main base, Bourn. Executives: F. G. C. Fison (chairman), and J. E. Harper (aviation manager). Fleet: eight Hiller 360s, seven Autocars and one Aiglet. In 1954 the operations carried out by Fisons Pest Control included helicopter charter—Middle East and British West Africa; agricultural and forest spraying in the U.K.; rubber plantation spraying in Ceylon; cotton spraying in the Sudan; and locust control in East Africa and the Sudan.

Prominent among the smaller independents are Jersey Airlines, first British operator to introduce the Heron. Three of these attractive 14/17-seaters are used on the company's services; this example was photographed at Gatwick.

"Flight" photograph

An impression of the final Test as seen from a T.A.A. Viscount

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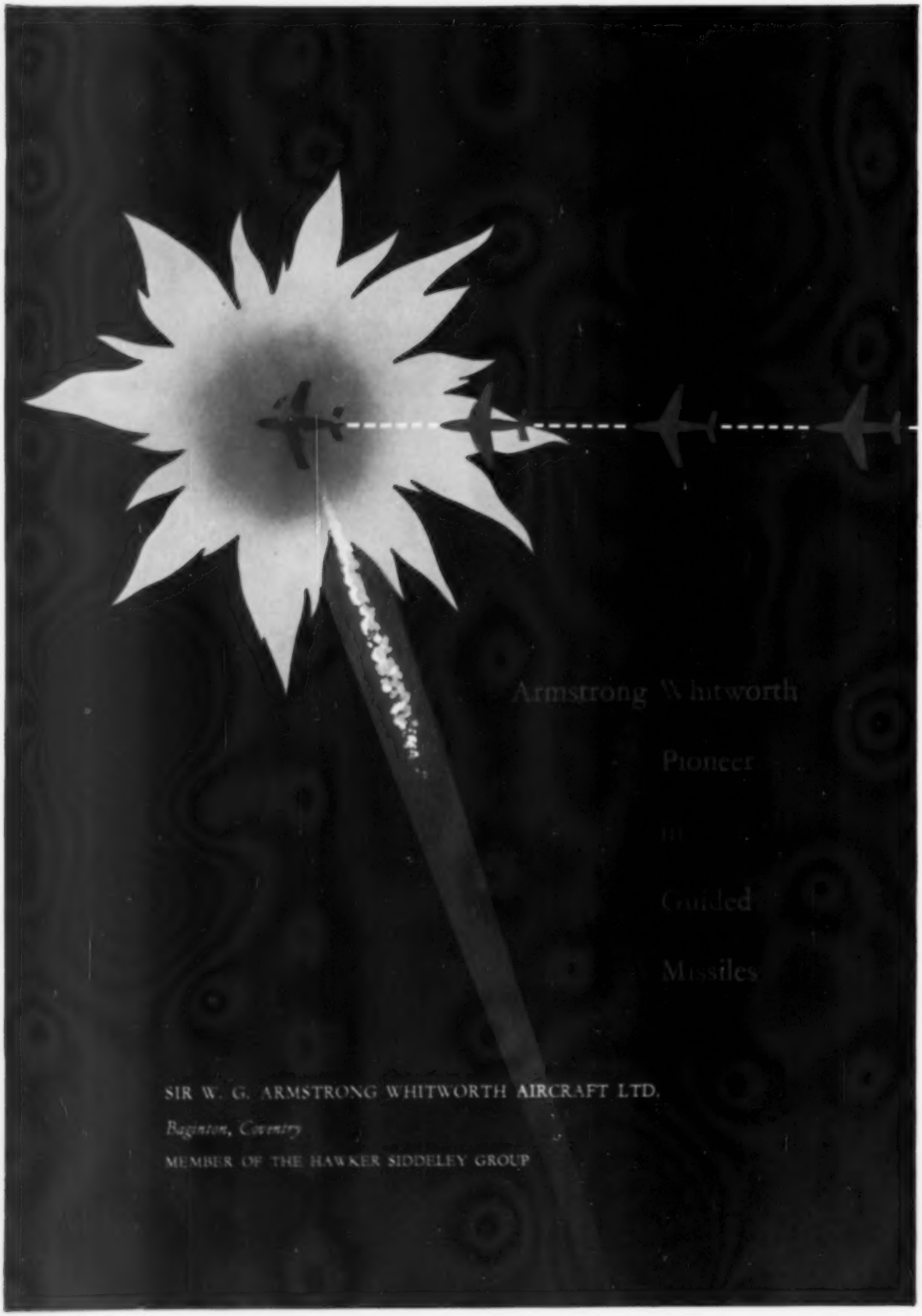
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BRITISH INDEPENDENT OPERATORS...

Herts and Essex Aero Club (1946), Ltd.—Operators of charter passenger services. Head Office, Stapleford Airfield, near Abridge, Essex. Main base, Stapleford. Executives: Roger Frogley (managing director) and P. Ayles (operations manager). Fleet: three Tiger Moths, one Hornet Moth, one Proctor, one Rapide, three Austers, one Gemini and one Messenger.

Hunting-Clan Air Transport, Ltd.—Scheduled passenger services, trooping and general charter. Head office, 5, Fitzhardinge Street, Portman Square, London, W.1. Main base, London Airport. Executives: M. H. Curtis (managing director), E. H. Baker (secretary), Col. B. J. O. Burrows (executive assistant to managing director), Capt. L. B. Greensted (technical manager), H. G. Matheson (commercial manager), J. Robinson (sales manager), R. W. F. Wingrave (traffic controller), D. T. Shaw (commercial economics controller), J. L. Logan (sales superintendent, Southern England), A. F. Dedman (accountant), L. V. E. Atkinson (base manager, London Airport), Capt. R. W. L. Mulliner (flight captain), H. B. Cundall (development engineer), A. J. Stocks (traffic superintendent, London area). Scheduled routes: *Northern Network Services:* London - Newcastle; Manchester - Newcastle; Glasgow - Newcastle; Newcastle - Paris; Newcastle - Amsterdam - Dusseldorf; Newcastle - Hamburg - Copenhagen; Newcastle - Stavanger - Oslo; London - Gibraltar. Newcastle - Brussels - Zurich (subject to approval). Newcastle - Belfast (approved by M.T.C.A. for future operations). *East African Safari Service* between London and Nairobi *via* Malta - Wadi-Halfa - Khartoum and Entebbe. *Central African Safari Service* between London and Salisbury *via* Malta - Wadi-Halfa - Khartoum - Entebbe - N'Dola and Lusaka. *West African Safari Service* between London and Accra *via* Tangier - Villa Cisneros - Dakar - Bathurst - Freetown. Fleet: eight Vikings, four Dakotas and two Yorks. On order: five Viscounts. During 1954 Hunting-Clan Air Transport carried 85,483 passengers.

(The airline is associated with the Hunting Group of companies, one member of which produces the Prince and—illustrated below—Survey Prince light transports; other member-firms operate the aircraft in many parts of the world in a variety of roles, including survey and executive transportation.)

Island Air Services (London), Ltd.—Operators of general charter and passenger services, and pleasure flights at London Airport. Head office, London Airport, Hounslow, Middlesex. Main base, London Airport. Executives: Monique Rendall (managing director and chief pilot), R. C. Rendall (director) and Jean Edwards (operations manager). Fleet: three Rapides.

Jersey Airlines (Airlines [Jersey] Ltd.).—Scheduled passenger services and charter flights. Head Office, 4, The Parade, St. Helier, Jersey, Channel Islands. Main base, Jersey. Executives: M. L. Thomas (managing director) and W/C. L. A. Egglesfield (general manager). Scheduled routes: Manchester, Coventry and Bournemouth to Channel Islands, Dinard and La Baule, London - Channel Islands - St. Brieuc - Lannion - Brest, Exeter - Channel Islands, Caen and Paris and inter-Channel Islands services. Application pending for Jersey - Bilbao (Spain). Fleet: three Herons and six Rapides.

Manx Airlines, Ltd.—Scheduled services for passengers and freight; ambulance and short- and long-range charter flights. Head office, Ronaldsway Airport, Ballasalla, Isle of Man. (London brokers: James Burness and Sons, Ltd., 15 St. Helens Place, E.C.3). Main base, Ronaldsway. Executives: G. H. Drummond (chairman), G. S. Hankinson (managing director) and T. L. Vondy (director). Scheduled routes: Isle of Man to Renfrew, Carlisle and Newcastle. Fleet: two Dakotas and four Rapides.

Marshall Flying Services, Ltd.—Charter and pleasure flights. Head office, The Aerodrome, Newmarket Road, Cambridge. Main base, Cambridge. Executives: A. G. G. Marshall (managing director) and H. E. Tappin (manager/chief pilot). Fleet: four Rapides, one Autocrat, five Tiger Moths.

Morton Air Services, Ltd.—Operators of scheduled passenger services, charter and air ambulance flights. Head office, Croydon Airport, Surrey. Main base, Croydon. Executives: T. W. Morton (managing director), J. J. Fargher (secretary), P. Eskell (commercial manager) and J. Warburton (chief pilot). Scheduled routes: Croydon to Jersey, Guernsey and Le Touquet. Fleet: four Doves, three Consuls and one Rapide. In 1954 Morton Air Services carried 14,100 passengers.

Olley Air Service, Ltd.—Scheduled passenger services, charter and air ambulance. Head office, Croydon Airport, Surrey. Main base, Croydon. Executives: T. W. Morton (chairman), S. A. Carter (secretary and commercial manager) and J. Warburton (chief pilot). Scheduled routes: Croydon to Jersey/Guernsey, and to race meetings. Fleet: three Doves, two Consuls and two Rapides. In 1954 Olley Air Service carried 12,500 passengers.

Skyways, Ltd., and Lancashire Aircraft Corporation.—Operators of scheduled passenger services, charter, trooping and pleasure flights. Head office, 7, Berkeley Street, London, W.1. Main base, Stansted. Executives: Eric Rylands (managing director), Sir Wavell Wakefield, M.P. (director), Charles F. Dickson (director), J. M. Twiss (general manager), A.Cdre. Sydney Smith (contracts manager), A. J. Henderson (secretary), M. D. Day (technical manager), H. P. Snelling (commercial manager), and Mrs. E. Whittaker (head of public relations and assistant to managing director). Scheduled routes: Crusader service, United Kingdom - Cyprus and Malta - Cyprus. Fleet: ten Hermes, nineteen Yorks (operated by Skyways), four Dakotas and twelve twin- and single-engined aircraft (operated by Lancashire Aircraft Corporation). In 1954 Skyways and Lancashire Aircraft Corporation carried 72,104 passengers and 3,900 short tons of freight; total hours flown by group 25,619; capacity ton-miles flown, 21,876,700.

Scottish Airlines.—Scheduled services and charter trooping. Head office, Prestwick Airport, Ayrshire. Main bases, Prestwick and Stansted. Executives: I. C. Grant (general manager), D. McConnell (secretary), W. A. Wilkinson (technical manager) and W. M. Cummings (London manager). Scheduled routes: Prestwick-Ronaldsway. Fleet: five Yorks and one Dakota. On order: six Prestwick Twin Pioneers. In 1954 Scottish Airlines carried 24,030 passengers and 208 short tons of freight; revenue passenger miles flown, 39,358,880; freight short-ton miles, 1,102,500.

Silver City Airways, Ltd.—Operators of scheduled vehicle-ferries, passenger services, helicopter freight services, charter and trooping flights and livestock transportation. Head office, 1 Great Cumberland Place, London, W.1. Main bases, Ferryfield, Blackbushe and Southampton. Executives: A.Cdre G. S. Powell (managing director), W. G. Franklin (commercial general manager) and S. A. Tennant (technical general manager). Scheduled routes: Ferryfield to Ostend, Calais and Le Touquet; Gatwick - Le Touquet; Birmingham - Le Touquet; Southampton - Cherbourg, Deauville and Guernsey; Blackbushe - Birmingham - Woodvale - Newtownards; and Belfast - Stranraer. Fleet: nine Bristol Superfreighters, six Bristol Freighters, two DC-3s; Rapides, etc. In 1954 Silver City carried 110,000 passengers and 58,052 tons of freight.

Transair, Ltd.—Scheduled passenger services, mail, freight and charter services. Head office, Croydon Airport, Surrey. Main bases, Croydon and Gatwick. Executives: G. H. Freeman (chairman and managing director), C. Nunn (supplies controller), H. S. Perren (commercial manager), C. W. H. Bebb (operations manager), P. H. Meadway (chief pilot), D. L. Brooks (chief engineer), and W. A. Richardson (chief inspector). Scheduled routes: Croydon - Paris and Croydon - Jersey - Guernsey (newspapers and mail); Croydon - Dusseldorf, Croydon - Hanover and Croydon - Hamburg (newspapers); inclusive tour passenger-services between Gatwick and Jersey, Lourdes, Perpignan, Hamburg, Klagenfurt, Venice, Turin, Toulouse and Alghero. Fleet: ten Dakotas.

Wolverhampton Aviation, Ltd. (in conjunction with Derby Aviation, Ltd.).—Operators of scheduled and charter services and a flying school. Head office: 78 Buckingham Gate, London, S.W.1. Main base: Wolverhampton. Executives: G/C. C. A. B. Wilcock (chairman), J. Harben (deputy chairman), L. E. T. Barley (managing director), E. W. Phillips, R. R. Paine, W/C. H. A. Roxburgh, A. C. Felts (company secretary), R. C. R. Cooper (chief engineer) and Capt. R. Wallis (chief pilot). Scheduled route: Wolverhampton - Jersey. Fleet: one Rapide, one Gemini and numerous light aircraft.

The versatile Hunting-Percival Survey Prince, both operated and produced within the Hunting Group, is used by a number of operators for survey and transport. Details of the Prince are given in the table on p. 337.

AIR ORGANIZATIONS

—on the Civil Scene: A Case of Initial Confusion

AIR transport today is a complicated business. That being so, the volume of published material relevant to civil aviation—a typical selection is shown above—should not come as a complete surprise to those encountering it for the first time. But this complication brings with it a complex interaction between many authorities, groups and associations, each concerned with a particular aspect of the air transport business and, it often seems, each with a more confusing set of initials than the last.

Anyone engaged in, or studying, international civil air transport today cannot go far before he encounters I.C.A.O. and I.A.T.A.; and yet, except for those airline specialists directly concerned with their activities, few outsiders could list accurately the differences in scope between them. Apart from this distinction between an agency of the United Nations and an association of airlines, how about A.L.P.A., B.A.L.P.A., and I.F.A.L.P.A.? A.T.A., I.A.T.A. and B.I.A.T.A.? And, inevitably, C.A.A. and C.A.B.? The apparent difficulties involved in getting straight in one's mind what, for instance, the A.R.B. is and does will need no emphasis for those who heard the long deliberations on these questions at the Comet Inquiry.

In this article, we have compiled the basic facts concerning the major organizations influencing commercial air transport today. The list is not exhaustive: apart from international groups, we have dealt only with British and American national organizations. Thus, energetic bodies such as the Air Industries and Transport Association of Canada, and many other Commonwealth groups, have had to be omitted.

Most of the organizations themselves fall into a number of fairly well-defined groups. There are government departments, such as the M.T.C.A. and the C.A.A. There are independent advisory councils (A.T.A.C.) and independent bodies to whom governments have delegated licensing, certification, investigating and other powers (A.R.B., C.A.B.). Some are trade unions, and a great number are technical and professional associations, on both national and international levels. Overshadowing most of their activities at some stage are the decisions of I.C.A.O., an organization of States endeavouring to develop the principles and techniques of international air transport in a practical, internationally agreed manner.

It is not surprising that there are so many such groups, for international air transport is becoming increasingly specialized in many directions. We hope that the brief accounts of the organizations which follow may help in removing much of the "initial confusion" of the past.

TWENTY-TWO ORGANIZATIONS: AN ALPHABETICAL REVIEW

Aerodrome Owners Association. Founded in 1934, the A.O.A. is the national organization which exists to protect and further the interest of aerodrome owners and operators at non-State-controlled aerodromes throughout the British Isles.

In addition to ordinary members (municipal or commercial aerodrome owners, managers and operators), there are a number of affiliate members (individuals and companies connected with civil aviation, such as aerodrome surveyors, chambers of commerce, electrical suppliers, oil companies and aviation insurers). A comparatively new branch is the associate membership, composed of municipalities which at present have no aviation activity but which are interested in reserving suitable sites for helicopter landings. At the Association's annual general meeting last month, it was announced that there were now 44 ordinary members and 46 associate and affiliate members—an increase over the previous year of 26 in the latter category.

The A.O.A. is at present compiling a list of existing and potential landing sites for rotorcraft, and is urging cities and towns in all parts of the country to make provision for the development of the helicopter for internal passenger and freight transport.

Close contact is maintained between the Association and the M.T.C.A., the Air Ministry and other Government departments, and the A.O.A. is represented on the National Civil Aviation Consultative Council. The Association is at present negotiating for an improvement in the provision of Customs facilities at non-State-controlled aerodromes.

CHAIRMAN, Councillor L. W. Biggs (Manchester Corporation); SECRETARY, S/L. A. W. Day. ADDRESS: Londonderry House, Park Lane, London, W.1.

Air League of the British Empire. The Air League was founded in 1909, its aims being "to disseminate knowledge and spread information showing the vital importance to the British Empire of air supremacy, on which its commerce, communications, defence and its very existence must largely depend." This objective has remained unchanged throughout the existence of the League, which is still today an independent body endeavouring to serve the cause of British aviation in every aspect.

Many of the Air League's activities have been concerned with military aviation and with encouraging an interest in aviation among young people. On the civil side, the League's current activities include a campaign for the overhaul of the British Customs service to comply with the requirements of air transport. It has also put forward a scheme for the future training of civil air pilots, and one for the improvement of air/sea rescue services.

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scheme for airline pilots, however, a Government inter-Departmental committee (quoted by Mr. Profumo in the House of Commons recently) has concluded that "the setting up of an independent civil aviation flying training scheme supported from public funds is not justified."

For the last three years the League has pressed the Government to devote greater attention to the uses of aviation in speeding up development in the Commonwealth and the Colonial Empire.

The League is a company limited by guarantee and not having a share capital, and is a registered charity.

CHAIRMAN, Air Chief Marshal Sir George Pirie, K.C.B., K.B.E., M.C., D.F.C., LL.D.; SECRETARY-GENERAL, F. N. Hillier, M.C. ADDRESS: Londonderry House, Park Lane, London, W.1.

Air Line Pilots Association. A.L.P.A. was officially established in July 1931 as the American airline pilots' union, although the first unofficial meetings had taken place in 1930. In the days of the depression it fought for the establishment in Federal civil air legislation of minimum wages and maximum flying hours. Since then, membership has grown from 603 in 1935 to over 9,500 (in active, apprentice and supervisory grades alone) in 1954. Total membership in all categories now exceeds 11,500.

The objectives of the Association, a non-profit organization, include the promoting of the interests of the airline piloting profession and the safeguarding of the safety of scheduled air transportation. The pilots of 41 airlines are at present represented in A.L.P.A. membership. Local, regional and national safety committees are included in the Association's organization framework, and A.L.P.A. participates in the investigation of all major air-carrier accidents.

With headquarters in Chicago, the Association has regional offices in New York and Los Angeles and, due to the profound effect of federal legislation on airline pilots and the necessity of continual liaison with Federal aviation agencies, maintains a permanent office in Washington also. As a member of I.F.A.L.P.A., A.L.P.A. was host to the Federation's 1953 meeting at Chicago. The president of A.L.P.A. has been president of I.F.A.L.P.A. for the past two years.

PRESIDENT, C. N. Sayen; SECRETARY, F. A. Spencer. ADDRESS: 55th Street and Cicero, Chicago, Illinois, U.S.A.

Air Registration Board. The foundations of the A.R.B. lay in the Gorell Committee, set up in 1933 to study the problem of the control of airworthiness of civil aircraft. This committee recommended that such control should come under an autonomous authority representing all parties principally interested in civil aviation. The Air Navigation Act of 1936 empowered the Secretary of State for Air to delegate some of his functions thus, and in 1937 this new independent body, a non-profit, limited company with the title *Air Registration Board*, was created.

The main duties of the Board are centred on the investigation of aircraft in relation to the issue and renewal of certificates of airworthiness. This investigation entails, *inter alia*, the publication of standards for design, construction and maintenance; the approval of manufacturers' organizations, engines, equipment, modifications, flight manuals and performance schedules; and the publication of notices to engineers, inspection leaflets, defect reports and an aircraft register.

Inter-related with these main duties is the responsibility for examining and licensing aircraft maintenance engineers and the holding of technical examinations for flight engineers and commercial pilots. In addition, the A.R.B. represents the U.K. at international discussions on airworthiness matters and undertakes the work of investigating and reporting on aircraft for underwriters and others. It is also able to assist Dominion, Colonial and foreign airworthiness authorities with duties similar to those of the Board.

The Council of the Board, which formulates policies, consists of 18 persons (who are not paid for their services). Four must be representatives of the operators; four must represent the aircraft manufacturers; four the insurance underwriters; and four must be independent members. One member (appointed by the M.T.C.A.) must represent the public and one (also appointed by the M.T.C.A.) must represent the professional pilots. The operators, manufacturers and underwriters appoint their own representatives and also the four independent members. An advantage claimed for this organization of the council is that no particular group wields a preponderating influence.

The staff of the Board numbers about 230, more than half of whom are technical staff, known as surveyors. The chief executive is also secretary to the Council, the execution of whose policies is his responsibility. The Board has two main offices in London, 16 area offices in the United Kingdom and eight offices overseas.

The Board's income comes from fees for issuing and renewing Certificates of Airworthiness, for approving firms, engines and equipment and for examining aircraft maintenance engineers and pilots. Minor sources of income are from contracts with foreign governments for advice and from the publication of technical literature.

The technical organization of the A.R.B. is divided broadly into design and inspection departments, each having various branches to deal with the Board's work in connection with the investigation of aircraft and associated equipment.

The Board has laid down the policy that as much as possible of the work and responsibility in airworthiness matters should be delegated to those actively engaged in the industry, thus obviating the need for a very large regulating authority. This is accomplished by granting approval to suitable constructors' design organizations (so that they may certify that the design of the aircraft complies with the Board's standards), and by granting approval to suitable inspection organizations (so that they may certify that the aircraft, engines, equipment and materials conform to the appropriate drawings and specifications).

In each case the Board retains the right of supervision. The principle of delegation is carried further at a later stage by authorizing suitably licensed aircraft engineers to certify that aircraft are maintained to the required standards.

[See also "Airworthiness" article, page 318.]

CHAIRMAN, Lord Brabazon of Tara, P.C., C.B.E., M.C., F.R.Ae.S.; SECRETARY AND CHIEF EXECUTIVE, R. E. Hardingham, C.M.C., O.B.E., F.R.Ae.S.; CHIEF TECHNICAL OFFICER, Walter Tye, O.B.E., B.Sc., F.R.Ae.S. ADDRESS: Brettenham House, Strand, London, W.C.2.

Air Transport Advisory Council. The A.T.A.C. was set up under the Civil Aviation (Air Transport Advisory Council) Order, 1947, made in accordance with the provisions of section 36 of the Civil Aviation Act, 1946 (now section 12 of the Civil Aviation Act, 1949). The duties of the Council were laid down as the consideration of representations from the public about the air transport facilities and charges provided by the Airways Corporations, and also of other air-transport questions referred to them by the Minister of Civil Aviation.

The Act and Order provided for a council consisting of a chairman appointed by the Lord Chancellor, and up to four members appointed by the Minister of Civil Aviation, one of whom must be a person with air transport experience, and another a person of experience in the operation of other transport services.

At first the work was slight, consisting entirely of consideration of representations from members of the public. Early in 1949, however, the Council was asked by the Minister of Civil Aviation to consider and make recommendations to him on applications from independent companies to operate certain scheduled services as associates of B.E.A. or B.O.A.C. These associate arrangements were not to involve services which overlapped or competed with existing or planned services of the Corporations.

In July 1952, the Council was reconstituted and new terms of reference were issued. These were to govern the Council's consideration of applications, both from independent companies and from the Corporations, to operate certain classes of scheduled services, and they gave effect to the revised policy on air transport which had been announced in Parliament in May of that year. Again the Council was to advise the Minister on the approval or rejection of these applications.

Almost all the work of the Council now consists of the consideration of applications to operate scheduled services. Last year (1953-54) a total of 118 applications were considered, of which 75 were recommended for approval. This year the number of applications has so far been considerably greater than in the previous year.

CHAIRMAN, Lord Terrington, K.B.E.; SECRETARY, R. F. Prosser, M.C. ADDRESS: 3 Dean's Yard, London, S.W.1.

Air Transport Association of America. Founded in January 1936 as a co-operative non-profit organization, A.T.A. is composed of U.S. flag airlines certified by the C.A.B. for scheduled service over regular routes. Its original membership of 12 operators has increased to 42 at present, of which 36 operate in and from the U.S.A., two associates having headquarters in Canada, one associate operating in Hawaii, one in the West Indies, one in Alaska and one in Latin America.

The general policies and activities of A.T.A. are an expression of the scheduled airlines' desire for joint action. The funds for the Association's operations are provided by the member-airlines on a *pro rata* basis according to their gross receipts. In addition to organizing conferences or committees (composed of airline executives) in each major field, the Association itself employs a number of specialist experts, both in Washington and at its regional offices, many of whom serve as executive secretaries of the various committees.

One of the major functions of the *Operations and Engineering Division* is its continuous contact and consultation with the C.A.A. and the C.A.B. on subjects such as safety regulations, air traffic control, navigation and landing aids, improvements to approach and airport lighting, and airport development generally. Similar links exist with the U.S. Air Co-ordinating Committee, the Services, I.C.A.O. and I.A.T.A.

The *Air Navigation/Traffic Control Group* is concerned with

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the operational and technical aspects of all-weather flight, including studies and developments for the Ultimate Common System to be standardized within approximately 15 years. Current problems concerning utilization of airspace, designation of airways, installation of appropriate *en route* and landing aids, establishment of suitable flight procedures and A.T.C. communications practices, and the allocation of schedules to avoid unnecessary A.T.C. congestion resulting in loss of scheduled reliability.

The A.T.A. *Traffic Department* is responsible for improving and standardizing the practices of the operators concerning tariffs, reservations, ticket arrangements, schedules, etc., and files the passenger-fare tariffs of member-airlines with the C.A.B. The *Air Transport Economics Division* collects, assembles and analyses tariffs, finance and other data used in preparing reports for the formulation of general industry policy, and studies traffic and other trends both in commercial air transport and in surface transport.

The *Public Affairs Department* supplies information regarding the air transport industry to the Federal, State and Municipal legislatures, with the object of guiding these bodies in the enactment of sound air transportation laws and of co-operating with public officials in their enforcement. Other A.T.A. departments deal respectively with questions of *finance and accounting, legal work,* and *public relations.*

Another organization owned by the air transport industry is *Air Cargo, Inc.*, which is responsible for all co-operative industry activities, concerning air freight and air express transport.

PRESIDENT, Earl D. Johnson; SECRETARY, J. D. Durand. ADDRESS: 1107 Sixteenth Street, N.W., Washington, D.C., U.S.A.

Aircraft Owners and Pilots Association. Although mainly concerned with private and business flying rather than commercial air transport, A.O.P.A. is a unique organization which has a significant voice in American civil aviation today. Its 40,000 members include airline pilots and business executives as well as pilots and owners of personal aircraft.

The Association is in fact the world's largest service organization for civil aircraft pilots, to whose interests and welfare it is dedicated. It was founded in 1939 by a group of Philadelphia businessmen-pilots, and has since then been prominent in helping to promote "virtually every forward step taken by civil aviation" in the U.S.A.

The objectives of A.O.P.A. are to attain "more extensive flying knowledge, greater freedom of use, more safety, increased engineering development in the field of the personal plane, its equipment and landing facilities." An associated non-profit corporation, the A.O.P.A. Foundation, Inc., is aimed at the reduction of accidents, deaths and severe injuries in personal aircraft, and it finances a number of research projects to improve the performance and safety of such aircraft.

Among the facilities available to members (apart from the Association's publications) are special insurance arrangements, legal aid, chart service and a complete flight-planning service. In addition, A.O.P.A. annually compiles members' reports on airports, and issues a certificate of approval to those airports offering satisfactory service to civil pilots.

CHAIRMAN, L. P. Sharples; PRESIDENT AND GENERAL MANAGER, J. B. Hartranft, Jr. ADDRESS: P.O. Box 5960, Washington 14, D.C., U.S.A.

British Air Line Pilots Association. B.A.L.P.A. is the trade union which is recognized as the sole negotiating body for pilots in the United Kingdom. It was formed in 1937 with some 200 members, and with two of its earliest councils at Croydon and Hythe.

At the beginning of the war, membership had increased almost to 300, and the Association had been recognized by all major operators and the Air Ministry. A notable step, following B.A.L.P.A. negotiations, was the introduction of a pension scheme for pilots in B.O.A.C. in December 1944, which has since acted as a model for many similar arrangements in many parts of the world.

With the rapid development of civil aviation in the post-war period, full membership of the Association has risen from 297 in 1945 to just under 1,500 at the end of 1954. Activities, too, have increased and have widened in scope. In 1948 B.A.L.P.A. played a prominent part in the establishment of I.F.A.L.P.A., the International Federation of Air Line Pilots Associations.

In 1950 a Flying Instructors' Section was established which, by the time of the Government policy decision leading to the closure of most of the Service flying schools, had a membership of over 300. The technical side of the Association's activity has developed considerably during recent years, and an important flight-safety memorandum published last December (as a suggested basis for legislation) refers to the limitation of flight time on the grounds of pilot-fatigue.

The Association is devoted to "the welfare of its members and the general good of civil aviation." It is at present recognized by all Government departments as well as operators, and possesses 32 local councils, 11 of which are based overseas.

PRESIDENT, The Duke of Hamilton and Brandon, P.C., G.C.V.O., A.F.C.; CHAIRMAN, Capt. A. Spooner (B.O.A.C.); SECRETARY, D. Follows, M.B.E., B.A. ADDRESS: 95 Mount Street, London, W.1.

British Independent Air Transport Association. The Association was formed as the British Air Charter Association in 1946 by thirteen charter companies (at that time the private-enterprise operators were permitted to carry out only charter activities), and was principally concerned with that sphere of air transport. Its aims and objectives were to promote the interests of its members. From its inauguration the membership of the Association increased rapidly to 39 companies (operating 230 aircraft) in 1948.

During the more difficult years since 1948, many companies were forced into liquidation. The actual number of the Association's members gradually decreased, but the general status and strength of the companies has increased. In September 1951 the Association's name was changed to the present one, in accordance with the general developments then taking place in British civil aviation whereby charter work was no longer an accurate description of the private operators' activities.

The objects of the Association at present include:—

"To encourage, promote and protect the British Air Transport Industry . . . but independent of the personal interests of any company, firm or person. . . .

"To originate and promote improvement in national and international law . . . and to effect improvements in administration. . . .

"To collect and collate statistics and other information on all matters affecting the air transport industry. . . .

"To improve and elevate the technical and general knowledge of companies, firms or persons engaged in the British air transport industry . . . and to promote just and honourable practice in the conduct of business and suppress malpractice. . . ."

There are four grades of B.I.A.T.A. membership; ordinary membership for operators with aircraft fleets having a total all-up weight of above 100,000 lb, between 25,000 and 100,000 lb, and below 25,000 lb respectively, and affiliate membership for non-operating companies with a definite and substantial interest in air transport. The Council of the Association, which is the executive body, is composed of operators, and at its monthly meetings considers all matters relating to air transport development, with particular emphasis on matters affecting the independent operators.

To assist the Council there are three advisory committees, set up to study technical problems of equipment, maintenance and overhaul; commercial questions concerning the carriage of traffic; and questions of safety in operation, respectively.

CHAIRMAN, M. H. Curtis (Hunting-Clan Air Transport); SECRETARY, A. M. Blakemore. ADDRESS: 13 Portman Street, London, W.1.

Civil Aeronautics Administration. The C.A.A. is an outgrowth of the original Bureau of Air Commerce established in 1926. The Civil Aeronautics Act of 1938 created the Civil Aeronautics Authority, and in 1940 the Authority underwent two reorganizations to attain its present form, which consists of two separately functioning parts, the C.A.A. and the C.A.B. While the Board is an independent organization, the Administration is a Bureau of the U.S. Department of Commerce.

The C.A.A. is charged with the encouragement and development of civil aeronautics, and operates four main departments dealing with the public. The *Office of Federal Airways* constructs and operates the vast U.S. system of airways, including the many aids to air navigation, and is responsible for the control of air traffic. The *Office of Airports* acts in an advisory and developmental way in the design and construction of airports, and administers the Federal Aid Airport Program.

The *Office of Aviation Safety* promotes safety through the certification of pilots, mechanics and other airmen, air agencies such as flight and ground-instruction schools, and aircraft; and works closely with all air carriers to maintain high safety standards. The *Office of Aviation Information* disseminates news, information and statistics on civil aviation generally, and provides flight information data for pilots.

In addition, the C.A.A. carries on or supervises technical development work in the field of aeronautics at its Technical Development and Evaluation Center at Indianapolis, Indiana.

The C.A.A. is headed by the Administrator of Civil Aeronautics, who is appointed by the President of the United States. There are assistant administrators for operations, administration and program co-ordination. Each of the six regional offices is headed by a regional administrator, as is the International Region. Each of the major offices at the Washington headquarters is headed by a director.

ADMINISTRATOR, F. B. Lee; DIRECTORS, J. H. Tippets (Federal Airways), H. H. Howell (Airports), A. S. Koch (Aviation Safety), Ben Stern (Aviation Information). ADDRESS: Department of Commerce, Washington 25, D.C., U.S.A.

Civil Aeronautics Board. The C.A.B., the law-making body of U.S. civil aviation, is an independent Federal agency headed by five members appointed by the President of the United States, with the consent of the Senate. A full term of office for a member is six years, with the President annually designating one member as chairman and another as vice-chairman.

The Board exercises its powers independently, and its decisions are final and not subject to review by any executive department or agency, with the exception that the President's approval is required in certain Board decisions affecting international and overseas air transportation.

In general, the Board performs three chief functions. These are (1) regulation of the economic aspects of domestic and international operations by U.S. air carriers; (2) promulgation of safety standards and Civil Air Regulations, and (3) investigation and analysis of civil aircraft accidents.

Economic Regulation: The C.A.B. issues certificates of "public convenience and necessity" authorizing domestic and international air-carrier services, and grants permits to foreign air carriers. It exercises regulatory powers over air carriers in the filing of tariffs, regulates and prescribes rates for the carriage of mail and determines service and subsidy mail-pay, paying any subsidy to U.S. air carriers from the Board's funds. It also regulates accounts, records and reports, mergers, loans and financial aid, methods of competition, and interlocking. With the advice and assistance of the Secretary of State, the Board participates in the negotiation of any agreements with foreign governments for the establishment or development of air routes and services.

Safety Regulation: The Board prescribes safety standards, rules and regulations, and has the power to suspend and revoke safety certificates after hearing. It also acts as "judge" in prosecutions brought by the C.A.A. concerning violations of the Civil Air Regulations and has the power to revoke and suspend certificates of both aircrew and operators.

Accident Investigation and Analysis: The Board investigates and holds public hearings on accidents involving civil aircraft and reports the facts, circumstances and probable causes; and makes such recommendations to the Civil Aeronautics Administrator as will tend to prevent further similar accidents. It makes public such reports and recommendations in the form and manner deemed to be in the public interest, and conducts special studies and investigations to reduce aircraft accidents and prevent their recurrence.

ACTING CHAIRMAN, Chan Gurney; SECRETARY, M. C. Mulligan. ADDRESS: Washington 25, D.C., U.S.A.

Commonwealth Air Transport Council. At the fourth meeting of the C.A.T.C. in London in June, 1953, Australia, Canada, India, New Zealand, Southern Rhodesia, the Union of South Africa, and the Colonial Empire were represented, in addition to the United Kingdom.

The object of the Council is to keep under review the progress and development of Commonwealth civil air communications, and to serve as a medium for the exchange of information and views between the Commonwealth countries on civil air transport matters. In addition, it considers and advises on such civil aviation matters as any Commonwealth government may wish to refer to it.

At the 1953 meeting, the most recent, a useful exchange of views on national policies for air transport took place, in the course of which an explanation was given to the Commonwealth delegates of how the civil aviation policy of the British Government had been designed to give greater scope to independent operators while safeguarding the position of the Airways Corporations on the established routes. Among other subjects discussed were the problem of noise at airports, future aircraft requirements and the question of regulating the lengths of runways to match the future development of civil aircraft.

CHAIRMAN. The Minister of Transport and Civil Aviation; SECRETARY, Mrs. V. Purnell. ADDRESS: Berkeley Square House, Berkeley Square, London, W.1.

Guild of Air Pilots and Navigators of the British Empire. It was suggested in 1928 by Sir Sefton Brancker (then Director of Civil Aviation) that qualified civil pilots and navigators should form their own company on similar lines to the great City Companies of London. This led to the founding, the following year, of the "Company of Air Pilots and Air Navigators of the British Empire"; later this was changed from "company" to "guild" in order to link with the ancient title of association of English craftsmen.

In 1930, the Air Ministry sent its draft proposals for the creation of a Master Pilot Certificate, and the Guild opened an employment bureau for pilots and navigators which still operates. Other important steps in the Guild's pre-war history were its recognition by the Air Ministry as the authority approved to examine flying instructors, in 1931; the award of the first Master Pilot Certificate to Capt. L. A. Walters, a Guild member, in 1954 (this ceased to be awarded during the 1939-45 war, but its issue by the Guild was recommenced in 1953); and the first award of the Trophy for Reliability, presented by Miss Alice Cumberbatch, in 1936.

After a wartime lull in activity, a Court was re-elected for the Guild in 1944, and later a Service membership was created for pilots and navigators of the Armed Forces. In 1946 the Guild moved into headquarters at Londonderry House. The Panel of Examiners was revived, and in 1946-47 issued and renewed 402 instructors' certificates. The Panel's work is now self-supported by fees agreed by the Ministry of Transport and Civil Aviation.

In 1950 the Brackley Memorial Trophy, for achievement in the operation of flying boats, was presented by Mrs. F. Brackley, and awarded for 1948-49 to J. Lankester Parker. In 1952, Her Majesty the Queen consented to become Patron of the Guild, and the Duke of Edinburgh later became Grand Master.

More recent activities of the Guild include the setting up of a committee to study the "training of future merchant air officers"; the appointment of the Guild to select the recipient of the "Derry and Richards Memorial Medal" presented by de Havilland employees; the consideration of the Guild becoming a City Company; and the celebration of the Guild's Silver Jubilee in November 1954.

MASTER, Capt. J. C. Harrington, O.B.E., F.R.G.S.; CLERK, L. A. Wingfield, M.C., D.F.C.; SECRETARY, Maj. J. L. B. H. Cordes, F.R.S.A., A.F.R.Ae.S. ADDRESS: Londonderry House, Park Lane, London, W.1.

International Aeradio, Ltd. I.A.L. was formed in London in January 1947 with principal airline operators among its shareholders. These now include B.E.A., B.O.A.C., Air France, K.L.M., Pan American, S.A.S., Sabena, Swissair, Qantas and T.W.A. The provision of ground technical services was originally its main function, but activities have since broadened out into other fields. The company's primary aim, however, remains the same—the provision of a service to aviation, wherever and whatever this service may be.

One major service offered by I.A.L. is that of planning and consultancy, including the interpretation of I.C.A.O. requirements, for organizations responsible for the provision of aerodromes, air routes, air traffic services, communications and radio aids to navigation. In many cases, also, I.A.L. is appointed as the actual operating agency providing radio communications, A.T.C. services, navigational aids, airport management, meteorological and allied facilities. Probably best known for its operation of aeradio and A.T.C. facilities at many points along the world's air routes, the company is active at about 80 locations in over 30 different countries.

In parallel with the expansion of I.A.L. operations, the company's engineering division has developed over the years, with the main object of maintaining a steady programme for advancing the techniques used in all phases of aeronautical radio and navigation. With a background of unique operational experience, the division now represents a balanced organization of systems planning, production, development and research.

Also provided are extensive training facilities for local staff abroad, and full-time training schools; and a wide range of specialist staff services. But it is probably through the medium of *Aerad Flight Guides* and *Trunk Route Manuals* that I.A.L. is best known. These are loose-leaf digests of aeronautical information which are amended and kept up to date daily.

The *Flight Guide* is the only known single source providing such information on a world-coverage basis. Details of radio facilities, aerodromes, let-down procedures and meteorological data are amended continuously, and any changes made at airfields or on routes are entered and issued as quickly as possible. World coverage for the *Flight Guide* is provided in self-contained sections by country, whereas the *Trunk Route Manual* covers certain long-range main routes only.

The information contained in these manuals comes from the Air Intelligence Department of the Ministry of Transport and Civil Aviation, where Aerad keeps a liaison section. This is supplemented by the company's own information sources.

CHAIRMAN: Sir Victor Tait, K.B.E., C.B.; SECRETARY, H. A. Adams, A.C.A. ADDRESS: Aeradio House, 40 Park Street, London W.1.

International Air Transport Association. I.A.T.A. is a voluntary association of the operators of scheduled international air services throughout the world. Its membership comprises over 70 active and associated members, carrying 86 per cent of the world's scheduled traffic, both domestic and international.

Functionally, I.A.T.A. is the agency through which the world's airline operators seek joint solutions to the many and varied problems of flying and doing business at the international level. It represents their views in other international agencies (and in

AIR ORGANIZATIONS . . .

particular has the closest co-operation with I.C.A.O.), administers their efforts to standardize and simplify practices and procedures in both technical and commercial fields, and conducts an international clearing-house for the settlement of interline transactions.

The present I.A.T.A. is the successor in function to the old International Air Traffic Association, founded in 1919. When the Chicago Civil Aviation Conference was convened in 1944 to provide a more commodious and flexible pattern of worldwide agreement on the regulation of civil aviation, the need for a more comprehensive organization of air transport operators was also apparent. The first general meeting of the new I.A.T.A. took place at Havana in April 1945, and the Association's stated purposes were:

"To promote safe, regular and economical air transport for the benefit of the peoples of the world, to foster air commerce, and to study the problems connected therewith;

"To provide means for collaboration among the air transport enterprises engaged directly or indirectly in international air transport service;

"To co-operate with I.C.A.O. and other international organizations."

The year-round direction of I.A.T.A. comes from an eighteen-member executive committee elected by the general meeting. The Association's affairs are administered by a secretariat of some 120 persons, scattered between the head office in Montreal and branches at New York, London, Paris, and Singapore. There are five standing committees, dealing with financial, legal, technical, traffic and medical affairs, each with a number of specialized sub-committees.

The creative activity of I.A.T.A. is based to a large extent on the willingness of members to share the benefit of their accumulated knowledge and experience in any particular aspect of air transport. This is done through the standing committees. While this method necessitates the attendance of hundreds of airline personnel at numerous I.A.T.A. meetings through the year, it is felt to offer advantages in minimizing secretariat overhead costs, emphasizing active experience and enlarging the knowledge of the personnel concerned.

A substantial part of I.A.T.A.'s technical work has consisted of putting forward the airlines' views in the development and application of the 15 I.C.A.O. annexes. Much of the technical committee's activity lies outside the I.C.A.O. framework, however. Regular technical conferences are held to exchange information and recommend policy.

Recently accepted by the technical committee were recommendations by the Association's new Helicopter Working Group, following discussions in Montreal last November. A second meeting of the working group has just taken place at Brussels.

Of outstanding importance is the work of the I.A.T.A. Traffic Conferences (organized in three regions). Rates, fares and associated matters are highly complex when agreements are subject to the approval of a number of governments; virtually all important bilateral agreements, dealing with the exchange of air transport services, however, now delegate rate-recommending powers to the I.A.T.A. conferences.

It is true to say that there is no significant aspect of airline operation that has not been the subject of I.A.T.A. discussion in an endeavour to improve, standardize and simplify methods and arrangements. On the subject of "facilitation"—the simplification, elimination and streamlining of border-crossing procedures and documents—the Association has worked together with I.C.A.O. towards the implementation of Annex 9.

PRESIDENT, Max Hymans (Air France); DIRECTOR-GENERAL, Sir William P. Hildred; SECRETARY, A. Laurence Young. ADDRESS: International Aviation Building, Montreal 3, Canada.

International Airline Navigators Council. I.A.N.C. held its first Convention in July 1950, since when its membership has increased to include nearly all the active airline navigators in the Western world, through their regional or company groups. One of the first aims of the Council was "to unite in one strong non-profit Council all unions and associations of air navigators."

In addition to this objective, the Council was formed to promote the interests of the air navigators' profession, promote safety in the air, work for the development of a strong aviation industry, provide for representation of the air navigators' profession at I.C.A.O. meetings, advance the science of air navigation, and work for the improvement of standards for air navigators. Another I.A.N.C. duty is to maintain an international office for the clearance of information of interest to air navigators generally.

The Council's main programme of work is carried out by four committees, dealing respectively with technical matters, legislation, publicity and contracts.

CHAIRMAN, H. Almin (Air France). ADDRESS: 2 West 45th Street, New York 36, N.Y., U.S.A.

International Civil Aviation Organization. At the International Civil Aviation conference in Chicago in 1944, representatives of 52 States adopted a convention providing for the establishment of I.C.A.O. The conference also drew up an interim agreement providing for a Provisional International Civil Aviation Organization (P.I.C.A.O.) to operate until the formal establishment of the permanent organization.

The aims and objectives of I.C.A.O., as stated in the convention, are "to develop the principles and techniques of international air navigation and to foster the planning and development of international air transport" so as, among other things, to ensure the safe and orderly growth of international civil aviation; encourage aircraft design and operation and the development of airways, airports and air navigational facilities; ensure that the rights of contracting States are fully respected; promote safety of flight in international air navigation; and promote generally the development of all aspects of international civil aeronautics.

P.I.C.A.O. came into being in June 1945 and I.C.A.O. was formed in April 1947, one month after the Convention on International Civil Aviation was ratified by the required 26 states. The convention superseded the provisions of two earlier agreements: the Paris Convention of 1919 (establishing the International Commission for Air Navigation) and the Pan-American Convention on Commercial Aviation drawn up in Havana in 1928. An agreement establishing the relationship between the United Nations and I.C.A.O. came into force in May 1947.

Prior to the formal establishment of I.C.A.O., the provisional organization secured concerted action from its members to provide and maintain the facilities and services necessary for air transport across national borders. Patterns for meteorological services, traffic control, communications, radio beacons and ranges, search and rescue organizations and other facilities were developed. P.I.C.A.O.'s work involved the drafting of recommendations for standards, practices and procedures designed to ensure the safety, regularity and efficiency of international air transport.

One of the most important activities of the permanent organization in the technical field was the review of these recommendations prior to the adoption by the I.C.A.O. council of international standards and recommended practices to regulate civil aviation in member-States. Once adopted, these international standards and practices, which are known as annexes to the Convention on International Civil Aviation, are amended from time to time as the evolution of aeronautical technology demands.

By February 15th, 1955, 15 annexes to the convention had been approved by the council and had come into effect. These covered (1) personnel licensing; (2) rules of the air; (3) meteorological codes; (4) aeronautical charts; (5) dimensional units to be used in air/ground communications; (6) operation of aircraft on international commercial air services; (7) aircraft nationality and registration marks; (8) airworthiness of aircraft; (9) facilitation; (10) aeronautical telecommunications; (11) air traffic services; (12) search and rescue; (13) aircraft accident inquiry; (14) aerodromes; and (15) aeronautical information services.

As required by Article 38 of the convention, contracting states notified I.C.A.O. of the differences between their national regulations or practices and the international standards contained in the annexes. In most cases, these differences have been few in number and of relatively minor importance.

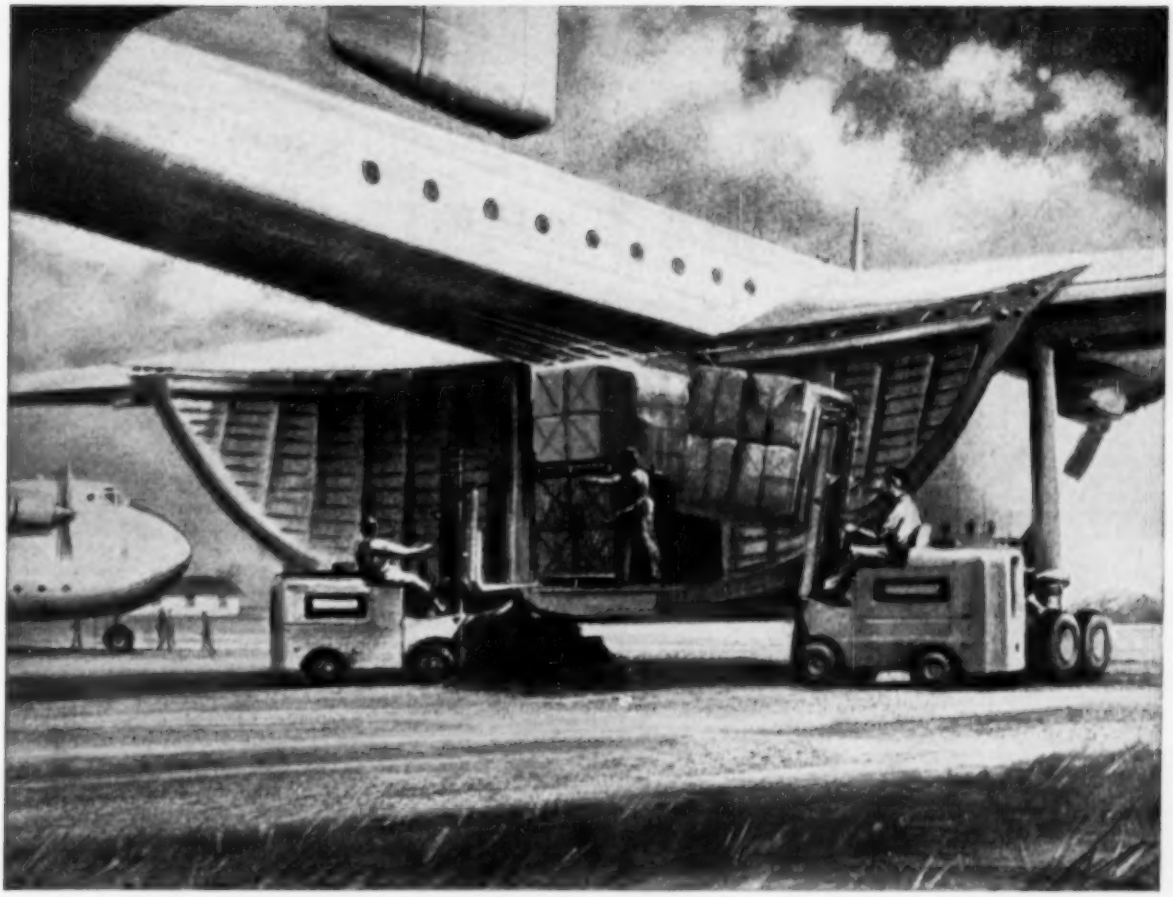
Meetings are held in each of I.C.A.O.'s eight flying regions to examine air navigation requirements and to specify particular procedures. These regional air navigation meetings draw up the "regional plans" which specify all facilities and services to be provided; after revision and approval by the I.C.A.O. Air Navigation Commission and the I.C.A.O. Council, these are submitted to the member-Nations for implementation.

Significant I.C.A.O. achievements include the following:—

Joint support. In regions of sparse population or undetermined sovereignty, it is sometimes necessary to provide air navigation facilities which can only be paid for by the collaboration of those governments whose airlines would make use of these services. In the North Atlantic area, through I.C.A.O. joint support programmes, the facilities which are maintained include nine floating ocean weather stations, two Loran stations (in Iceland and the Faroe Islands), air traffic control and communications services in Iceland and communications and meteorological services in Greenland.

Technical assistance. I.C.A.O. is a participant in the expanded programme of technical assistance of the United Nations and the specialist agencies: the Organization's annual budget for this purpose has varied from year to year, but is in the neighbourhood of $1m. The help given by I.C.A.O. is designed to assist national development rather than international development, but because of the nature of aviation, it is difficult to distinguish between these two factors, and the airlines of the world normally profit by the development of internal facilities, such as meteorological services.

Air law. I.C.A.O. is charged with the development of international air laws. In this regard, the Organization has successfully concluded two international air law conventions—the Geneva Convention on mortgage rights and the Rome Convention on damage done to third parties on the surface. A third convention, designed to replace the Warsaw Convention of 1939, has been



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AIR ORGANIZATIONS . . .

drafted and a meeting to complete this will be held in the Hague in September of this year.

PRESIDENT OF THE COUNCIL, Dr. Edward Warner; SECRETARY-GENERAL, E. C. R. Ljungberg. ADDRESS: International Aviation Building, Montreal 3, Canada.

International Federation of Air Line Pilots Associations. I.F.A.L.P.A. was founded in April 1948 at a conference held in London and attended by representatives of 16 countries. The intention was that some organized effort should be made to ensure that the opinion of pilots was voiced and some attention paid to their views in the sphere of international civil aviation legislation; and from the beginning emphasis was placed on the Federation's relationships with I.C.A.O.

Divisional meetings of I.C.A.O. were attended in 1949, and from the beginning of 1950 full observer status was accorded to the Federation by I.C.A.O. Since that date I.F.A.L.P.A. representatives have attended regional, divisional and special meetings of I.C.A.O.

There are now 21 members of the Federation, representing some 10,000 pilots. Membership is open to all national Air Line Pilots' Associations, and individual associations are also eligible. Nine I.F.A.L.P.A. conferences have already been held; that for 1955 is scheduled to take place at Montreal.

Externally, the object of the Federation is "to provide a democratic body capable of presenting to international organizations pilot opinion in the aviation fields of conditions of service, international legislation, technical development and standards of safety."

Internally, its objects are "to provide a forum for discussion among pilots of all matters of common interest, to facilitate the exchange of information and advice on technical and labour problems, to advance the professional status of the pilot by encouraging progress in his technical standards, and to foster goodwill and comradeship among the pilots of the world."

One most useful recent technical meeting organized by the Federation in London comprised a discussion between pilots and industry representatives on the subject of airborne radar.

PRESIDENT, C. N. Sayen (Air Line Pilots Association); SECRETARY, D. Follows, M.B.E., B.A. ADDRESS: 95 Mount Street, London, W.1.

International Federation of Independent Air Transport Operators. F.I.T.A.P. (the initials come from the Federation's French title) is an organization grouping both national associations of independent companies, and individual companies. Its main objects are to secure measures of freedom and opportunity for independent airlines and to foster and protect the interests of private enterprise in civil aviation.

Founded in 1947 by the British and French national associations, F.I.T.A.P. now represents 57 private airlines in Europe, Asia, Africa and North America. The combined fleets of its members comprise some 510 transport aircraft, including 150 four-engined machines.

PRESIDENT, Ludwig G. Braathen; SECRETARY-GENERAL, J-M. Riche. ADDRESS: 43 rue de la Chaussée d'Antin, Paris IX.

Ministry of Transport and Civil Aviation. The Ministry of Civil Aviation was established in 1945 to organize, carry out and encourage measures for the development of civil aviation, for the promotion of air safety and efficiency and for research on air navigation. It was to plan British air services in consultation with the Corporations, and to look after the interests of private and charter flying by British independent operators.

On October 1st, 1953, the Ministry of Transport and the Ministry of Civil Aviation were amalgamated. This amalgamation was foreshadowed in November 1951, from which time the two offices of Minister of Transport and Minister of Civil Aviation had been held by the same person.

In civil aviation matters, the Minister may give general directions to the publicly-owned airline corporations on matters affecting the national interest. He also approves associate arrangements between airline corporations and independent air transport companies for the operation of scheduled services.

Additional responsibilities include the provision, administration and equipment of State-controlled aerodromes and other ground services in the United Kingdom; the regulation of civil flying; air safety and investigation of accidents; the adoption in the U.K. of the standards and practices recommended by I.C.A.O.; and the negotiation of international air transport agreements. The Minister has two Parliamentary Secretaries, one to deal with transport matters and one with civil aviation.

The regulatory functions of the Ministry under the Civil Aviation Act of 1949 include such matters as the registration and certification of civil aircraft and the licensing of civil crews and personnel. The Ministry issues Certificates of Airworthiness on the recommendation of the Air Registration Board, which investigates civil aircraft for this purpose.

A standing advisory body of experts, the Air Safety Board, is responsible under the Minister for keeping under continuous review the safety needs in British civil aviation and for recommending measures calculated to promote safety, in respect of both the operation of British civil aircraft throughout the world, and the provision of an efficient system of ground facilities for all civil aircraft operating over the U.K.

A series of bilateral air transport agreements for scheduled air services is in force between the Governments of the U.K. and most of the countries through which British airline services operate. As the diplomatic channel is frequently used for consultation on civil aviation matters, a number of M.T.C.A. officers have been attached to missions in Commonwealth and foreign countries, since the end of the war, as Civil Air Advisers or Attachés.

There are some 100 civil aerodromes in the U.K. and 34 of these are directly administered by the Ministry. Of the Ministry's vote for civil aviation purposes, just over one-third is contributed to the construction, maintenance and equipment of aerodomes.

MINISTER OF TRANSPORT AND CIVIL AVIATION, the Rt. Hon. J. Boyd-Carpenter, M.P.; PARLIAMENTARY SECRETARY (CIVIL AVIATION), John Profumo, O.B.E., M.P.; PERMANENT SECRETARY, Sir Gilmour Jenkins, K.C.B., K.B.E., M.C. ADDRESS: Berkeley Square House, Berkeley Square, London, W.1.

Society of British Aircraft Constructors. The main object of the S.B.A.C. is stated in the opening paragraph of its memorandum of association: "To encourage, promote and protect the British aircraft industry and generally to watch over and protect the general interests of companies, firms and persons engaged in such aircraft industry, but independently of the personal interests of any company, firm or person."

Most aspects of the Society's work are equally relevant to both civil and military aviation. A list of the standing committees which serve under the technical board gives an indication of some of these aspects; they deal with airworthiness, research and technological development, education and technical information, standards, production technique, materials, and equipment. Airworthiness is, of course, a particularly significant subject in air transport, and the S.B.A.C. provides four members of the Air Registration Board.

One recent civil-aviation project was the publication of a standard method for estimating the direct operating costs of civil aircraft. While not attempting to produce thereby absolutely realistic cost figures (at a time of considerable cost fluctuations), the S.B.A.C. method does provide a valid basis for operating-cost comparisons between aircraft types.

DIRECTOR, E. C. Bowyer, C.B.E.; SECRETARY, R. T. Hughes. ADDRESS: 32 Savile Row, London, W.1.

Society of Licensed Aircraft Engineers. The S.L.A.E. is a technical and professional association established to further the advancement of aeronautical engineering, and in particular that branch which is the province of the aircraft maintenance engineer. A major part of the Society's work is devoted to the education, qualification and general advancement of the professional aircraft engineer.

The Society was founded in 1944 by engineers serving in the Services, civilian-manned Flying Training Schools, and the small wartime B.O.A.C., who were looking to civil aviation to provide them with their post-war employment. A constitution was drawn up to bring into being a purely technical society, with no trade-union or political activity or connection. Although the title referred only to licensed engineers, the constitution has been progressively modified to cater for "all categories of professional aircraft engineers in civil and Service aviation concerned with the servicing, maintenance, overhaul and repair of aircraft, aero-engines and ancillary equipment"—including those not required to hold licences.

A comprehensive programme of educational and technical services is provided, including publication of a monthly journal, library service, special technical information service, educational and students' panel activities, organized instructional courses at various firms, and evening classes, lectures, visits and film shows on a variety of subjects.

There are six grades of S.L.A.E. membership: full membership, associate membership, associateship, companionship, student membership and honorary membership. The Society established in 1953 its own system of technical examinations for the associate-member grade. An employment bureau, various information and advice services, and special insurance schemes are among the facilities available to members.

The Society makes two annual awards; a gold badge for the best paper published in the journal and a cash prize to the winner of the Dorothy Spicer Memorial Prize Essay Contest. There are six S.L.A.E. area councils in this country and, among the 18 principal branches, ten are overseas.

PRESIDENT, A. C. Jack; CHAIRMAN, M. T. Holdham; GENERAL SECRETARY, P. F. Murray. ADDRESS (secretariat): 1 Bell Street, Maidenhead, Berks.

AIRWORTHINESS

—and its Effect on the Design of Civil Transports

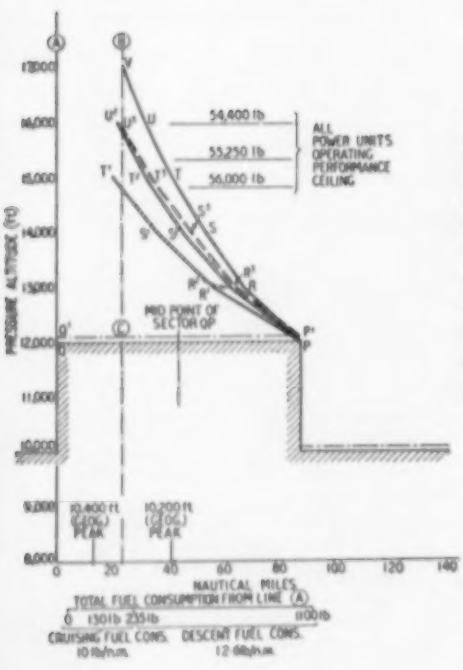
EVERY British-made airliner operated by a British airline can display insignia consisting of a lion rampant surrounded by the words "British Certificate of Airworthiness." Before this badge can be applied, the design and performance of the aircraft, the procedures of its manufacture, the ability of the manufacturing firm's staff and a host of other factors have to be searchingly examined to ensure that all that reasonably can be done to make the aircraft safe has been done. And the behaviour of the machine, and the effect of maintenance procedures and modifications, will continue to be inspected as long as it continues to fly.

Airworthiness is largely commonsense. If an aeroplane is properly designed and built by people who know their job, and operated conscientiously by trained flight and servicing crews, then a C. of A. will probably be issued without any serious trouble.

It was not always so. In what might be termed "the biplane era," the body responsible for civil airworthiness was the Air Ministry's Directorate of Civil Aviation. Gradually, this department formulated a set of "requirements" with which all civil machines had to comply, and these were published as Air Publication 1208. The design part of this was a very slim document.

Air travel was then an unconventional form of transport, and the acceptable level of risk was distinctly higher than is tolerated today. "Incidents" were, therefore, relatively frequent, when balanced against a factor such as miles flown. On the other hand, early transport aircraft were generally quite capable of getting down safely into most ordinary fields (aerodromes were themselves scarcely better) and services were, with very few exceptions, flown only in conditions providing for visual landing. Wing loadings were low and power loadings high, resulting in low stalling speed, relatively short take-off run, but hopeless engine-out performance. In the latter condition, the regular practice was to hop the hedge into the next field. Landings were normally made upon wheels with either weak brakes or no brakes at all; coefficient of ground friction was, therefore, almost immaterial. During the approach, drag could be put on to order simply by side-slipping.

Typical design "requirements" were some elementary laws regarding structural strength, a clause requiring provision of flutter-damping mass-balances on the ailerons and another specifying a fireproof bulkhead behind each engine.



A drift-down chart for a hypothetical machine. Subscripts 1 to 3 refer to weights of 54,400, 55,250 and 56,330 lb at I.S.A. + 20 deg C; curve VUTSRP is for 56,000 lb at I.S.A. + 22½ deg C. The shaded region is below the minimum safe altitude at I.S.A. + 22.5 deg C; broken line Q' P' is for I.S.A. + 20 deg C. Line A is the entry to the critical sector of the route.

Practically nothing was done about civil airworthiness between 1939 and 1944, and the story can conveniently be resumed in the uneasy post-war era. A retrospective chronology of the 1930-1945 period is given later, from the point of view of the development of performance requirements.

Towards the end of the Second World War, the Provisional International Civil Aviation Organization—which today is the familiar I.C.A.O.—was formed, and in 1946 this body developed a set of airworthiness and performance requirements which it proposed to apply to all new transports introduced to international scheduled service after January 1st, 1951, and to all aircraft engaged in such service after January 1st, 1954. These I.C.A.O. requirements were based on American domestic legislation and, as they differed significantly from the airworthiness code to which British transport aeroplanes had all been designed, their acceptance would seriously have penalized the British industry and operators of British aircraft.

In 1947 and 1948, the British delegations to I.C.A.O. exposed some of the anomalies and weaknesses of the proposed requirements and succeeded in preventing their final adoption; at the same time, the Ministry of Civil Aviation (as it then was) initiated the formulation of a completely new code of "performance requirements" on a logical and rational basis. The theory of the new idea was planned by the A. and A.E.E., Boscombe Down, and, with the help of the Air Registration Board, the Ministry of Supply, the Met. Office, British manufacturers and operators, and with the co-ordination of the M.C.A., the code was developed into what was the first nationally adopted, rational and up-to-date code of airworthiness and performance requirements in the world. The principles of the code were accepted by I.C.A.O. in 1949, and in 1951 an I.C.A.O. Standing Committee was set up to formulate detailed requirements for international use.

The "airworthiness" part of the new requirements was introduced in the United Kingdom as British Civil Airworthiness Requirements 1951, Section D. The "operational" part was brought in by Regulations 34 and 34A of the revised Air Navigation (General) Regulations of October 1952. As a signatory to the I.C.A.O., Great Britain has an obligation (although without compulsion) to incorporate international airworthiness requirements in B.C.A.Rs. In 1948, all the I.C.A.O. requirements then existing were incorporated in B.C.A.Rs.

When the Air Registration Board consider a new Requirement to be necessary, it is mapped out in draft form and circulated to all interested organizations. The draft is then debated at one of the four A.R.B. technical committees, on which are representatives of the M.o.S., B.A.L.P.A. (see page 314), the various research establishments and the Operational Requirements section of the M.T.C.A.

Very often, manufacturers will genuinely consider that the new requirement is too severe, and they will attempt to have it reduced; designers may feel that the Board are asking for a wasteful margin *above that needed for safety*. For example, in estimating landing performance, it has to be assumed that, at some occasion, a pilot will bring his aircraft in much too fast; the debate then would centre upon fixing a reasonable maximum speed at which a pilot might be expected to attempt to complete his landing. All discussion is, however, in perfectly good faith, and no British manufacturer has ever been known to attempt to pass off a new design as meeting requirements when, in fact, it did not.

All requirements are framed as broadly as possible. In nearly every case, a target is stated, and the manufacturer is left to meet the target in his own way. In the design of a new airliner, discussions with the A.R.B., and other interested organizations, start at the project stage on the drawing board, and they continue throughout the whole life of the aircraft. When the prototype begins its flight trials, an A.R.B. pilot will frequently sit-in and note the performance and handling, and later on will carry out trials himself. A recent instance of this was the tropical testing of the Britannia 100 at Tripoli, the test crew for which included Mr. D. P. Davies, the A.R.B.'s chief test pilot.

When the aircraft is approaching the stage at which it is ready for service, the manufacturer issues a service and instruction manual, which is approved by the A.R.B., and the A.R.B. will concurrently prepare and publish the Flight Manual for the type. When all investigations are over, the Board's Executive submit a report to the Council including descriptions of all novel features of the design for which the requirements as written did not apply, together with notes on any failure to meet requirements. When

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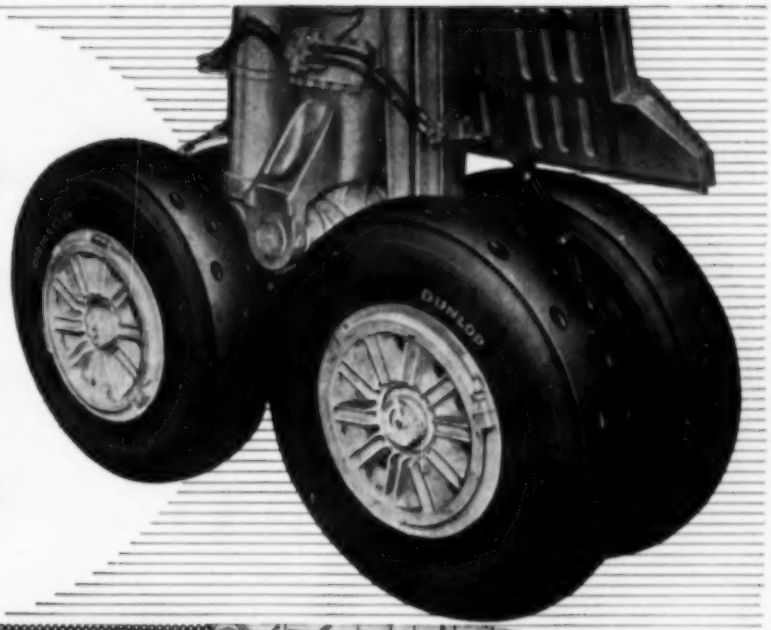

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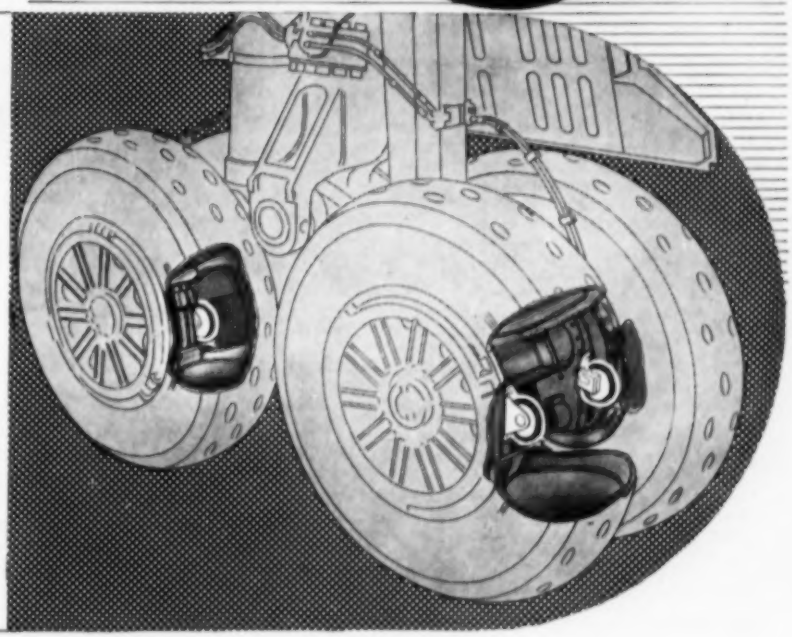

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AIRWORTHINESS . . .

they are satisfied, the Board issue a recommendation to the M.T.C.A. for the issue of a Certificate of Airworthiness.

As we have said, airworthiness is largely commonsense. Never is it possible to consider that a particular aircraft or component is "jolly well made" and leave it out of discussion. *Failure has to be assumed*, and the principal aim of all airworthiness requirements is to ensure that any design can cope with any failure or combination of failures which might reasonably be anticipated. In the case of a component or system, the aim is to make it "fail safe"; in the case of the whole aircraft, it is mandatory that any normal pilot (and the "normal pilot" is one of the few factors which cannot be defined) should be able to complete a flight safely in the event of any type of mechanical failure which might be suffered. There are, of course, failures which could not reasonably be expected—a fact of which this country is now painfully aware—and it is probably true to say that there will always be some failures, or sequences of events, which might be termed "unforeseeables." The fact that this is true merely serves to underline the importance of "airworthiness" in ensuring that, after such a sequence of events, no disaster is ever inevitable.

Amplifying this, it can be said that, although an airline captain is regarded as very skilled and competent, he is assumed to make every likely mistake at some time, but never all at once. Components are assessed on the assumption of sound, but not unreasonably careful, standards of manufacture and maintenance. On the other hand, it is assumed that no unreasonable error will occur; for example, if a drawing were to call for an H.T.S. bolt it is assumed that that would be the material used.

Structures

Perhaps the most basic part of an aircraft is its structure, and here it is largely possible to leave stressing to the company's own design staff; errors are today almost unthinkable—they are made, but scarcely ever remain long undetected. Of course, any structure breaks when it is loaded beyond its limit, and to some extent safety could be increased simply by choosing a design factor so high that the strength loading of the structure could never even approach the proof value in flight. Such a machine would, however, be hopelessly uneconomic, and would never find a buyer.

Mention of structural strength leads naturally to the vexed subject of fatigue, which is—even in simple test-specimens—still imperfectly understood. From the airworthiness point of view, it is valueless to attempt to determine the actual fatigue life of a particular airframe. What must be established, however, is a safe fatigue life, and this also is at present extremely difficult to assess. Having fixed a "life" for a part, it is then enough to replace the part at the expiry of its "allotted span," or, in some cases, to leave it alone knowing that its safe life is greater than any period of service. When considering a whole fleet of aircraft, it is a safe rule to assume that, if fatigue is expected after x hours flying, then trouble is possible after $x/5$ hr and probable after $x/2$.

Structural design to reduce proneness to fatigue can now be carried out fairly readily; this again is largely a matter of logical and sound engineering, including as it does the elimination—as far as practicable—of stress-raisers such as sharp corners, and careful attention to all changes of section and all radii. At the recent Institution of Production Engineers' conference a speaker pointed out that these things were of far greater importance than is (for example) a smooth finish.

It seems certain that, during the next few years, it will be desirable—and practicable—to pay greater attention to reducing the incidence of fatigue. A great deal could be done today by eliminating windows and (possibly) by increasing the proportion of integrally-reinforced structure; but any changes of this nature are necessarily gradual.

With regard to "systems" such as electrics or hydraulics, each item has to be assessed on its merits. To do any worthwhile job, a modern transport has to be complex, and the possibility of failure has to be weighed against the function of the component and the demands of servicing and maintenance.

For example, the flap mechanism has to be so arranged that it is virtually impossible for flap to be applied on one side of the aircraft only; on the other hand, the performance requirements of aircraft are such that, when a machine is properly matched to its aerodromes, flapless landings are possible, and so failure of the whole flap system is not considered unduly dangerous. In future aircraft, in which boundary-layer control may be employed with the flaps to obtain a very high maximum lift coefficient, flap failure might have a much more serious effect, and duplication would then be required.

Detail design can have a profound influence upon the performance of a system, particularly measured over the life of the aircraft. For example, it is generally agreed that one electric cable with 48 cores, leading to a 48-pin socket, is a much better arrangement than 48 cables each with its own fastenings if studied from the viewpoint of ease of disconnection during an overhaul. On the other hand, a multi-pin socket can, if wet or containing a loose wire-chopping, lead to random failures of a number of circuits. Where a circuit is vital to the safety of the aircraft the possibility of a faulty connection has to be made as difficult as possible, and a good example of this is the flying-control system. Following fatal accidents in the early days, it has been laid down that the turnbuckles in the control circuits shall be of different form, or shall have different thread sizes, making coupling in the reverse sense impossible. Similar precautions are also taken with powered controls, and duplication of jacks and duplication or double-duplication of power supply is also required. Even with all engines out of action an airliner still has to remain fully controllable, and powered controls thus have to provide for actuation either manually or by power from an electric battery or ram-air turbine.

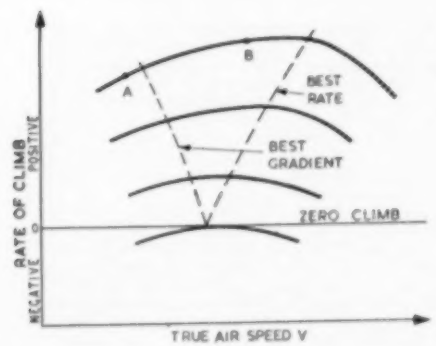
Even the simplest component of a power system is examined and type-tested, and enters service with an approved "life." Progressive development may extend the life, or may permit a longer life when associated with a particular function in a specific type of aircraft. Functional mock-ups of complete aircraft systems are of enormous value in determining the performance of accessories and systems; for example, the load-sharing of alternators is very much more easily (and accurately) simulated by a mock-up of the whole electrical system than by running the units alone on a test-bed.

B.C.A.Rs. can, by arrangement with the authority concerned, be adjusted to suit a foreign country operating British aircraft. For example, Trans-Canada Viscounts are at present being operated on JP-4 fuel for reasons of availability, although kerosine is greatly preferred in this country; there are also British airliners flying abroad with locally designed seats and lap straps which have not been investigated for compliance with B.C.A.Rs.

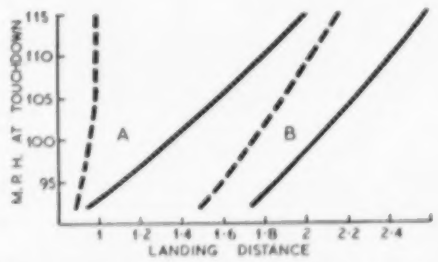
Any new requirement is automatically applicable to all types of aircraft designed after it becomes enforceable, and it is naturally desirable that aircraft already built should attempt to meet it. But requirements are never retroactive; for example, should it be decided to introduce a requirement calling for the employment of "non-flam" hydraulic fluid, it would not require the conversion of every machine already in service.

The remainder of this account is largely concerned with the aspect of airworthiness which, although of an intangible nature, exerts the greatest single influence upon the design of aircraft. This aspect is that of performance, and is the vital link between the aircraft, the job which it does, the routes which it flies, and safety.

As noted previously, the requirements for general airworthiness



Curves of rate of climb against speed for varying weights (the top curve being for minimum load). Point A might be the climb at 1.15Vs and point B at about 1.4Vs.



Landing curves for a Constellation, showing the great difference between holding the nose high down to 70 m.p.h. (full lines) and retracting flaps, nosing down and applying full brake (broken lines). Curves A are for high friction and B for low friction, i.e., wet or icy runway. All curves assume full flap and optimum attitude on the approach.

AIRWORTHINESS . . .

contained in the old A.P. 1208 were very meagre. The performance requirements were similarly sparse, and were purely arbitrary. On take-off, aircraft had to be able to clear 20m (66ft) within a distance of 600m (1,968ft); landing distance was fixed at 250m (820ft) for aircraft weighing under 6,600 lb, and 300m (984ft) for all heavier aircraft. There were no "engine-out" requirements.

During the 1930s, there began the complete replacement of early transports by cantilever monoplanes. The latter introduced numerous refinements such as flaps, retractable undercarriages, variable-pitch airscrews and a complete absence of external bracing, and they also caused a great acceleration of the trend towards lower power loading and higher wing loading. Such machines demanded a more comprehensive airworthiness performance code than had hitherto existed.

In Great Britain, World War II began before such a revised code had been formulated, but the U.S.A. were ahead of us in introducing "modern" transports and they were accordingly the first to expand their performance code. Originally each State of the Union had its own ideas upon air safety, but a uniform system was obvious (readers may like to ponder upon the consequences of the former) and this was provided by the formation of the Civil Aeronautics Administration (see p. 314).

One of the characteristics of the original U.S. code was the establishment of an absolute limit upon V_s, the stalling speed. When the new monoplanes came, V_s had to be allowed to rise—and it has kept on rising, in easy stages, ever since, as the latest American transports show. At an earlier time, the length of field required for take-off increased to the point at which a pilot could no longer study the strip by eye and decide whether or not it was sufficient. For the first time, therefore, account had to be taken of the route flown and the conditions experienced. The increase in V_s also made necessary the introduction of certain safeguards in engine-out performance of a sufficiently comprehensive nature to supersede the code based on V_s itself.

A major characteristic of the U.S. code was that rate of climb was made a function of stalling speed—actually $0.035\ V_s^3$. No account whatever was taken of climb gradient. As a result, manufacturers tended to meet the requirements by employing various devices which did not necessarily effect any real improvement in safety. Taking the Boeing 377 (Stratocruiser) as an example, elevator power in this aircraft is insufficient to achieve V_2 with the c.g. fully forward, so a restriction was placed keeping the c.g. near the aft limit. The rate of climb curve on page 319 underlines the difference between British and American aircraft now in service; the British aircraft retains a positive climb right down to the stall, whereas the American aircraft, with highlift flaps and its nose well up, begins to sink at an air speed greater than the stall.

Again, U.S. transports are all air-cooled, and a standard for a hot day was specified as 100 deg F, at which the *en route* performance was adequate for appropriate cooling. Nevertheless, a new requirement was later introduced establishing the minimum climb speed as 1.21 V_s to meet the requirements for the standard atmosphere. This speed, known as the take-off safety speed, increased the field length needed for a particular aircraft.

At the same time, automatic safety features were introduced to ease the pilot's task. Most important of these devices was the automatic feathering airscrew; auto-feathering is generally initiated by a signal whenever torquemeter pressure falls below a datum. Such equipment represented the first attempt to relate reliability with performance; previously, there was no guarantee that performance requirements would improve detail engineering.

Concurrently with the introduction of the new C.A.A. performance code went the first systematic mapping of the obstructions around airfields. This was rendered doubly necessary by the fact that the code took no account of climb gradient. In order to get economic field length, engine-out performance and (in particular) directional control were greatly improved; it is appropriate to cite the Constellation in comparison with the earlier twin-engined Lockheed transports. Naturally enough, one of the chief aims of the U.S. manufacturers was to reduce stalling speed, and this can all too easily be done at the expense of a reduction in stall quality. As a result, the U.S. code had to introduce a number of very detailed requirements regarding stall quality. Under B.C.A.Rs., a full examination is made of the stall itself, irrespective of stall-warning.

This period up to about 1951—which might justifiably be termed the "American era"—gave, for the first time, reasonable attention to the several factors mentioned. On the other hand, temperature and humidity of the air were still unaccounted for and there were other ill-effects. For example, pilots were presented with complex flight manuals involving varying c.g. limits and varying safety speed. A more serious trend resulted directly from the engine-out climb requirements; power loading was decreased and the failure rate rose. In fact, the more likely an engine was to fail, the more climb was necessary, so forming a vicious circle.

Broadly speaking, most transports in service could at one time (1948-50) be divided into those which could meet requirements but had unreliable engines, and those which had reliable engines but which could not climb. The DC-3 is an obvious example of the latter; and it must be noted that such aircraft as the DC-3 and Rapide are still in service, although they have no hope of meeting modern performance requirements. Permission for them to do so results from the fact that it is reasonable to assume that the majority of their troubles have been ironed out years ago, and today they are exceptionally reliable. Any aircraft intended to replace them has to meet modern requirements fully and, although this places the newer design at a great disadvantage, it is logical in order to ensure safety of the untried machine.

The revised C.A.A. code was largely written around the actual performance of certain aircraft then in use, and it incorporated accountability for airfield height, size, obstructions and *en route* terrain; it did not, however, account for temperature, and this parameter has still not been fully allowed for in the American code.

A Rational Code

As previously related, the United Kingdom set about establishing a completely new code of performance requirements after World War II. The proposals for full temperature-accountability were made by this country at the first I.C.A.O. session of 1946, and a rational method of allowing for the random variation in aircraft performance was made available in 1948. A new code embodying these principles was proposed by the U.K. at the third Air and Operations session in 1949; it was intended to establish a certain minimum safety on each flight and to err on the safe side where circumstances were unknown. Basic minima were calculated, below which a pilot might be in trouble; there might be random advantageous features associated with a particular case, but, for example, if an aircraft were allowed to decelerate below its safety speed, a pilot could not reasonably be blamed for losing control.

Suppose that the likelihood of engine failure is 1 : 1,000; the aircraft then needs an engine-out performance such that there is a 1 : 100,000 chance of going below the minimum datum, having regard to all factors. This datum is defined as the flight path below which the aircraft should not, by reason of lack of performance, be brought except on the occasions allowed by the design incident probability. For example, on take-off the datum is an obstacle clearance of 35ft at the end of the runway, which includes a certain amount for missing the obstacle and a smaller amount to allow for the height which might be lost due to the effect of small corrective turns.

This concept of a design incident probability (of 10^{-5}) is one of the basic criteria of the rational concept of aircraft performance aimed at in British certification. In assessing the incident probability, the contributions of all the possible cases are summated, although the cases with one or two engines out probably account for over 90 per cent of the whole. Such statistical investigation emphasizes engine reliability and also correlation between one failure and another (for example, a loose airscrew blade from No. 3 engine might cause complete failure in No. 4). Correlation between failures cannot be ignored and the aircraft systems have to be so arranged that, apart from the possibility of dirty fuel or oil, or that of a ground engineer making a similar mistake on each engine, no combined engine failures are likely.

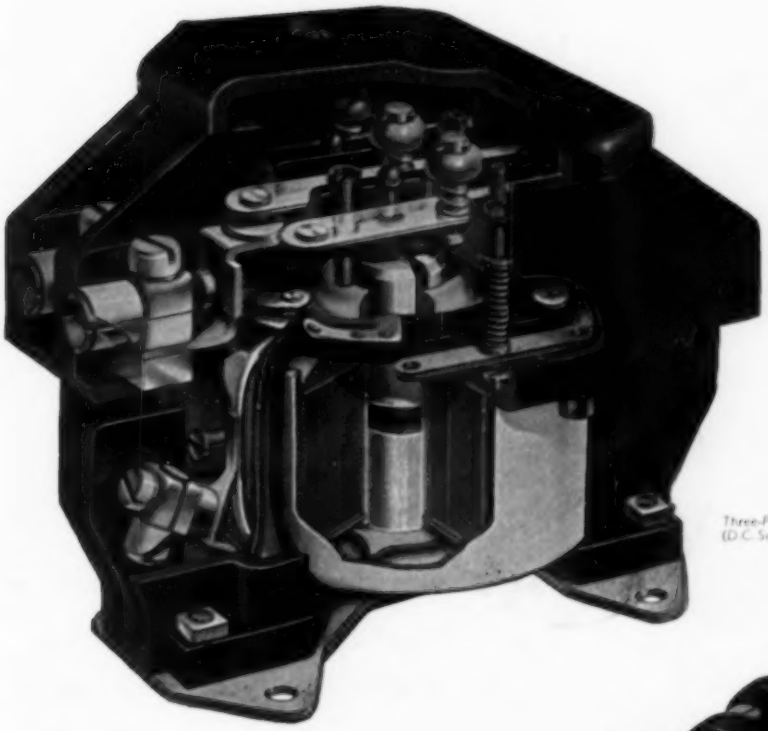
Reliability of flaps, brakes, and similar components all affect performance, and the consequences of unreliability can be evaluated. In the design stage it is impossible to state the reliability of, say, a hydraulic system, but intelligent engineering can ensure that the system will not cause a catastrophe. Thus, it is commonsense to ensure that, even with two engines out, a long-distance aircraft will retain full control, full radio facilities, ice protection and other essential services; control must also be retained even with all engines failed. Naturally, some loss of services has to be tolerated but an aircraft is difficult enough to land with two engines out in any case, and it is essential that the pilot's task should be eased as far as possible.

In all cases, engines must be made re-startable in the air. If an aircraft were to develop an *en route* vibration the pilot would like to be able to shut down each engine in turn to find the source of the trouble. With a piston engine re-starting is generally quite straightforward, the only likely difficulty being the possibility of coring of the oil cooler and freezing of the airscrew hub in the feathered position. With a gas turbine, however, there may be a definite maximum re-light altitude and, although not usually a critical consideration, this should be taken into account when applying *en route* performance requirements.

This type of problem, which was first met with the Comet 1, demanded the establishment of a scheduled all-power-units-operating height which should not be greater than the re-light altitude. This permitted flexibility in the accepted re-light altitude by ensuring that the aircraft was properly matched to its route. At the same time, the drift-down technique was employed to enable the aircraft to clear all obstacles by an adequate safety

(*Continued on page* 336)

The Electrical Aspect

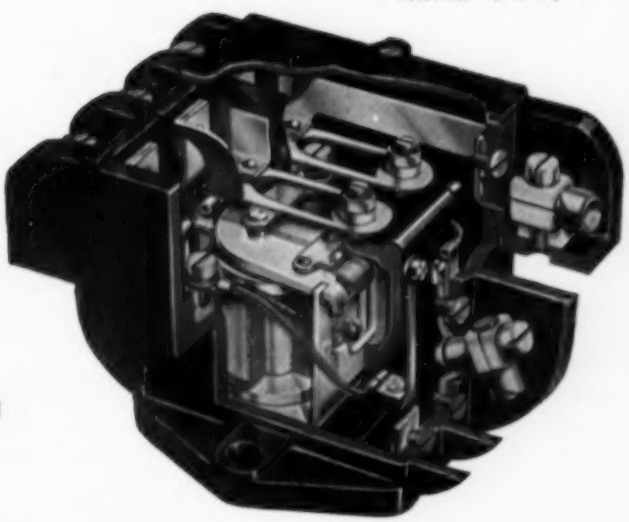


Three-Phase Contactor
(D.C. Solenoid operated)

Switchgear . . .

in relation to its application must be light, compact and easily maintained.

Three-Phase Thermal Trip



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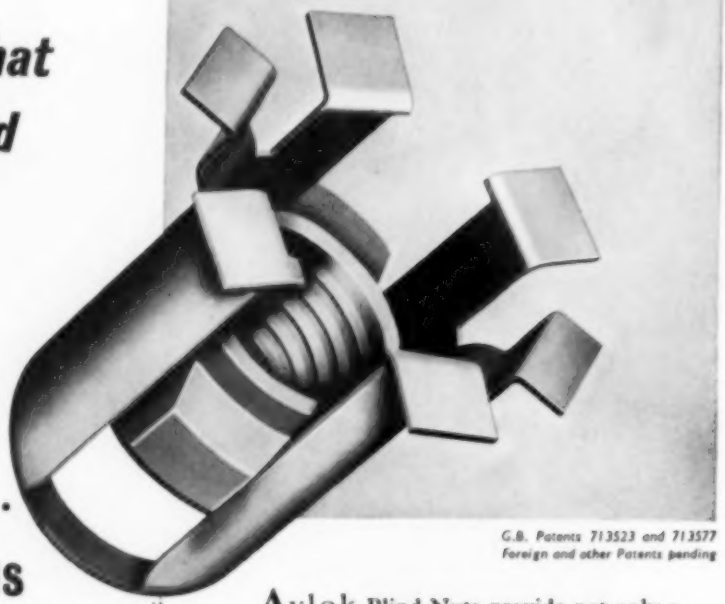

G.B. Patents 713523 and 713577
Foreign and other Patents pending

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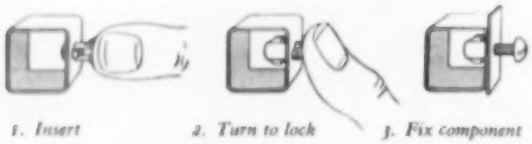

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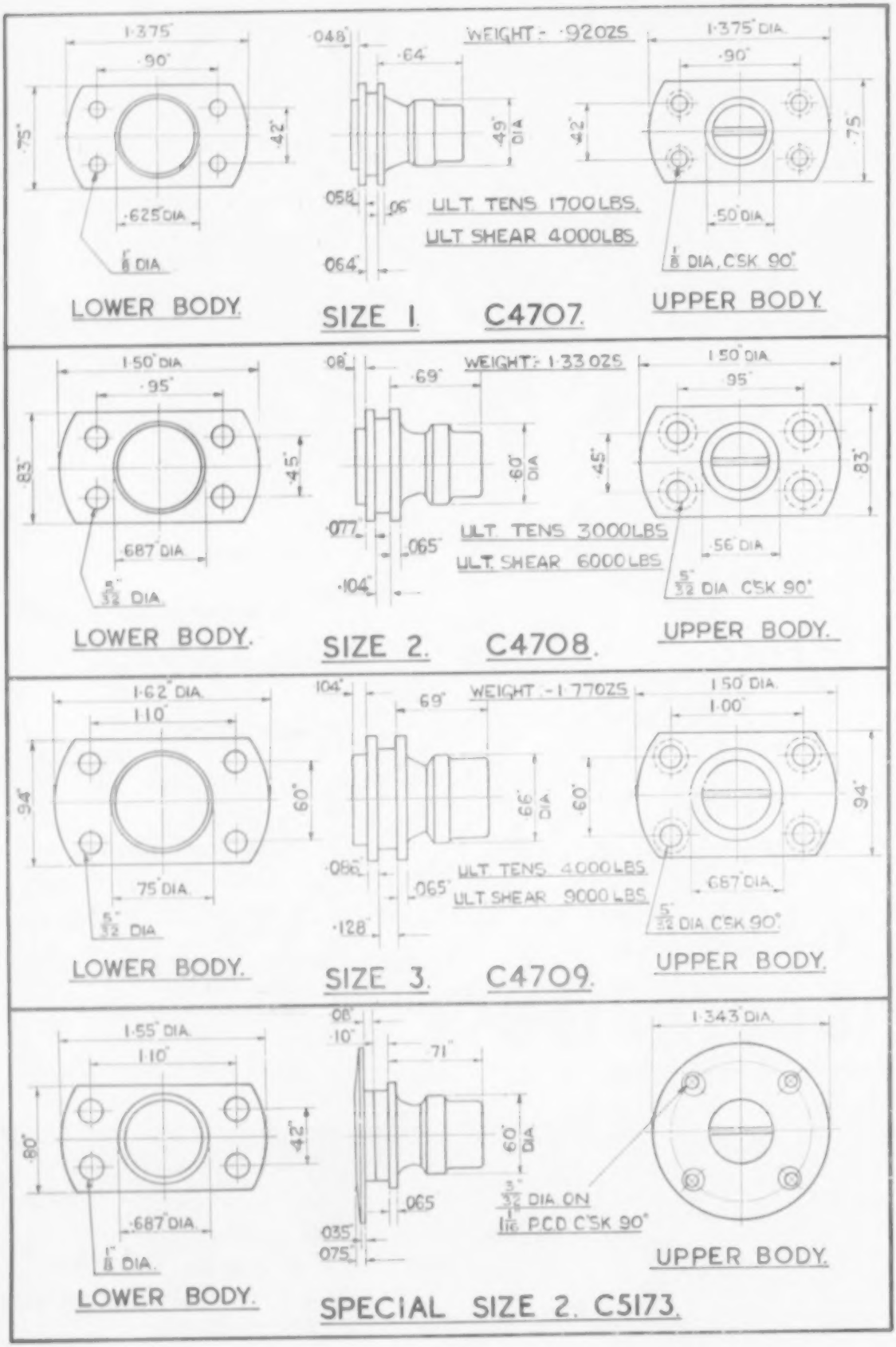


FILE THIS FOR REFERENCE

Bristol Britannia 100 (first production aircraft); four Bristol Proteus.

TRANSPORT AIRCRAFT · 1955

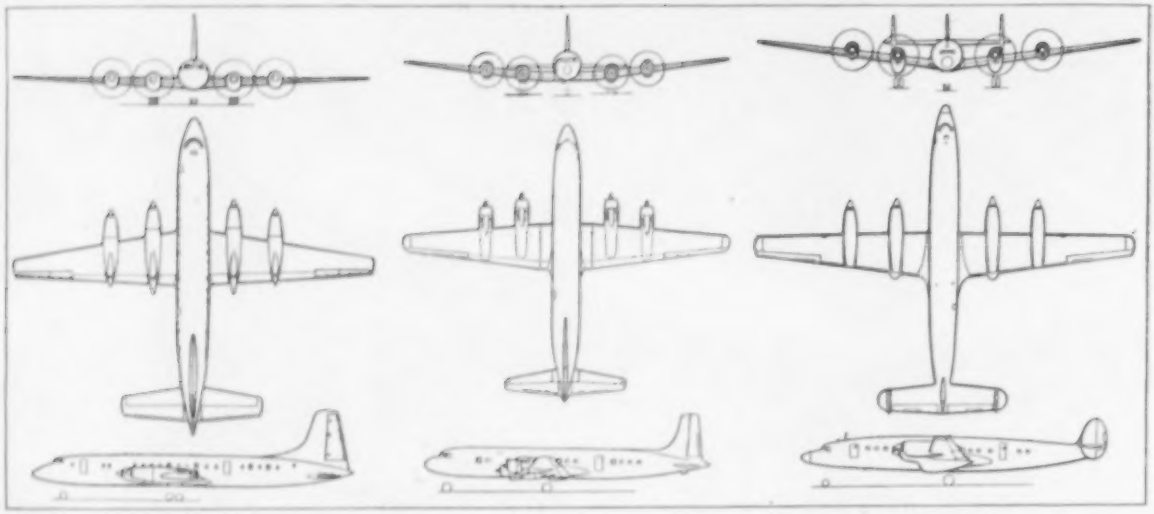
THIS survey covers the majority of aircraft in scheduled airline service today or intended for service within the next few years. Though some 50 types are illustrated, it is of interest to note that the bulk of the traffic is carried by less than a score of them; and the cost of developing and introducing a modern transport aircraft is such that the number of widely used designs is most unlikely to increase. Aircraft are considered in these pages in four groups: first, the big, long-haul transports designed primarily for inter-continental-service; second, the rather smaller medium-stage class used for distances of up to 1,000-1,500 miles; third, short-haul and feeder types, including helicopters; and, finally, aircraft intended mainly for freighting.

Long-range Transports. Technically, the two designs illustrated on this page are the most ambitious ever offered for long-distance air travel. The Comet, in initial Series 1 form, entered service with B.O.A.C. in May 1952; subsequently, essentially similar versions were introduced by Air France and the French independent airline U.A.T. Because of its restricted stage-length performance (about 1,500 miles) and passenger capacity (36-40), the Ghost-powered Comet 1 was, economically, a marginal proposition, and no large overseas orders were attracted. Initially, however, it fulfilled its main purpose—the proving of the jet-travel concept—with heartening success. Its cruising speed of nearly 500 m.p.h. and high level of comfort resulted in astonishingly good load-factors (which compensated for the knife-edge economics), and no severe operational problems were encountered.

There seemed no reason to doubt a great future for the slightly larger, longer-range, Avon-powered Comet 2, which was due to come into South Atlantic service with B.O.A.C. in 1955 and had been ordered by several overseas airlines. Early in 1954, however, two B.O.A.C. Comet 1s broke up in the air, the cause of the accidents later being diagnosed as fatigue failure of the pressure cabin. To guard against this wholly unexpected cause of trouble, future Comets will employ thicker fuselage skinning and re-designed windows of circular, instead of rectangular, form.

Incorporation of these and other features required as a result of the investigation into the Comet accidents, followed by pre-service trials, will delay the re-introduction of the type to scheduled service; but despite the delay the Comet remains the most advanced transport on the market today. There is little reason to regard future Comets as any less attractive than they

de Havilland Comet 3 (prototype); four Rolls-Royce Avon.



Three projected "Atlantic express" types to scale (left to right): Britannia 300 L.R. (span, 140ft; a.u.w., 165,000 lb); DC-7C Seven Seas (span, 127ft 6in; a.u.w., 139,000 lb); Lockheed L.1449 (span, 150ft; a.u.w., 177,000 lb). The newer L.1559 will have a longer cabin and higher a.u.w.

TRANSPORT AIRCRAFT, 1955 . . .

appeared, in prospect, when the prestige of the Series 1 was at its peak. Though the modifications required will involve some weight penalty, this will be almost entirely offset by the increased power being offered by the latest marks of Rolls-Royce Avon.

B.O.A.C. recently announced an increased order for Comets, expressing their intention to operate 20 "New Comets" instead of 12 Series 2s and five Series 3s. This new Comet's characteristics had not been announced at the time of writing, but it is expected to have a strong resemblance to the Series 3, a 58/76-seater designed for stage-lengths of up to 2,600 miles. It would thus be capable of handling the majority of international long-distance routes. The Comet 3's capacity payload of some nine tons, coupled with its cruising speed of 500 m.p.h., would make it an extremely productive vehicle.

Whereas speed and jet-smoothness are the predominant features of the Comet, the Britannia's attractions lie in a combination of the four major qualities which influence operators and passengers alike; capacity, range, speed and comfort. So far as can be determined, it appears to offer more of each quality than any of the American piston-engined transports which have dominated the long-range market for the past ten years. Three versions of the Britannia are in production and a fourth will follow shortly. The first is the Mk 100, destined for service—early in 1956, subject to the award of a C. of A.—on B.O.A.C.'s routes only. The initial role of this version will be to replace the Argonauts on inter-Commonwealth routes. Fifteen Mk 100s have been ordered, inter-Commonwealth routes. Fifteen Mk 100s have been ordered, stage lengths of 1,500-2,000 miles. The Mk 100 is powered by 3,780 h.p. Proteus 705s and its fuselage is 115ft long; subsequent Britannias will have 4,150 h.p. Proteus 755s and a 10ft 3in fuselage extension.

These "stretched" versions include the Mk 250 and the Mk 300, of which the former is intended as a composite passenger/freight aircraft (with additional loading doors and a strengthened cabin-floor forward), and the latter a passenger transport. Both types can be supplied in "L.R." (long-range form), with fuel capacity increased from 6,800 to 8,300 Imperial gallons by the incorporation of extra tanks in the outer wing panels and centre-section.

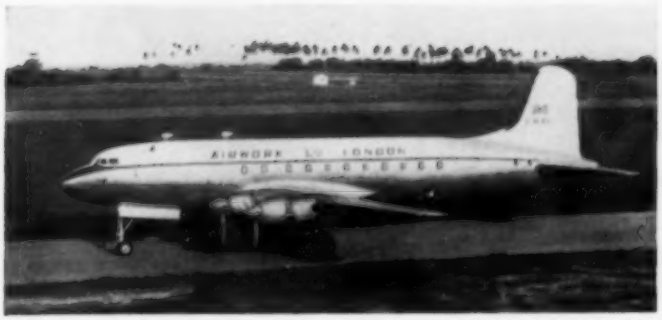
B.O.A.C. have ordered eight Mk 300s, the first of which is being built alongside the initial batch of Mk 100s, and ten Mk 300 L.R.s. Eight long-range versions of the Mk 250 are to be built at Belfast by the Short factory—three for the Ministry of Supply, who will lease them to British independent airlines for trooping work, and five "in anticipation of demand."

Payload-range curves for the Mk 300 show it to be capable of lifting 30,000 lb for 3,800 miles and 18,000 lb for 5,180 miles; those for the L.R. model give a still-air range of 4,500 miles with a 30,000 lb load, and 6,100 miles with a 16,000 lb load. Capacity payload of the Mk 250 is 36,500 lb.

Economic cruising speeds for all Proteus-powered Britannias are expected to be in the region of 350 m.p.h. Appreciably higher speeds are expected of Britannias re-engined with the BE.25 turboprop, a 4,000 s.h.p. unit now under development which is designed to give constant power up to 20,000ft, enabling the aircraft to operate at maximum weight from shorter strips and/or higher take-off altitudes and temperatures. B.O.A.C. have already ordered 60 BE.25s for installation in Mk 300s when these revolutionary power-units are available; other operators (such as Qantas, whose fleet of ten Super Constellations will carry the airline through the next four or five years) will prefer to operate BE.25-powered Britannias from scratch. The constant-power turboprop, however, is not an immediate prospect, and, on published, guaranteed performance data, the Proteus-powered

This Alitalia DC-6B (top left) is powered by four 2,500 h.p. P. and W. Double Wasps; the B.O.A.C. Argonaut below it has four Rolls-Royce Merlins of 1,760 h.p. Heaviest, most powerful and most luxurious of transatlantic airliners is the Stratocruiser (below), powered by four 3,500 h.p. Wasp Majors.

Wright Turbo-Compounds of 3,250 h.p. drive the DC-7, shown (right) in the colours of Delta-C.andS. The D.H. Comet 2 (below) has four Rolls-Royce Avons of 7,350 lb thrust. The commercial future of this mark of Comet has yet to be decided.



Still among the most widely used of long-range transports is the Constellation 049 (above), powered by four 2,200 h.p. Wright radials; the example shown belongs to El Al, national airline of Israel. Above it is an Airwork Hermes IVA, a pressurized 56-seater powered by four 2,100 h.p. Bristol Hercules.

Britannia is an impressive transport aircraft in its own right.

Until the advent of the Britannia and Comet, the majority of long-distance operators' post-war requirements had been met by two American manufacturers, Douglas and Lockheed. Douglas have captured the larger share of the market, receiving orders for a total of well over 500 aircraft in the DC-6/7 series. The series grew out of the non-pressurized DC-4, built in large numbers during the war as the Skymaster. Latest in the line is the DC-7C Seven Seas, a long-range transport designed specifically for non-stop service between North America and Europe. This aircraft is the classic example of the "stretch" process, as shown by the following comparative figures for the DC-7C and (in parentheses) a typical DC-4: length, 112ft 3in (93ft 10in); span, 127ft 6in (117ft 6in); gross weight, 139,000 lb (73,000 lb); total power, 13,600 h.p. (5,800 h.p.); capacity payload, 16,740 lb (12,000 lb); speed, 343 m.p.h. (200 m.p.h.).

Development of a basic design to such an extent has been made possible largely by increases in power, which Douglas have, in order to keep the design competitive, converted into additional range and speed rather than capacity. The company's efforts have been highly successful, as witness the ever-increasing production line at Santa Monica (and success in the airliner-manufacturing industry is cumulative). The improvement in operating economy, however, appears to have stopped short at the DC-6B; the extra work-capacity of the DC-7 is not sufficient to offset its higher initial cost. Approximate purchase prices of the DC-6/7 series are: DC-6, $700,000; DC-6B, $1,200,000; DC-7, $1,800,000; DC-7C, $3,600,000. In general, operators are unlikely to accept the DC-7 or DC-7C as a replacement for the DC-6B now in service—except where extreme ranges are involved, a classic example being the North Atlantic.

DC-7s have been in American domestic use since late 1953, their most significant achievement being the opening of direct coast-to-coast service. The DC-7B, which carries additional fuel in the inboard nacelles, will be seen in midsummer, wearing Pan American colours, on the North Atlantic route, and the type will also be introduced this year by South African Airways, who have bought three, at a total cost of some $5,900,000, for the Johannesburg-London route. Delivery of Seven Seas will begin in mid-1956 to Pan American, who have ordered 15. Other DC-7C operators will be B.O.A.C., who have lately received Government authority to buy ten as an "insurance" against delays in Britannia development, S.A.S., Sabena and Swissair.

Lockheeds have achieved success comparable to that of Douglas in the long-range transport field, with the sale, to date, of some 400 civil models of the Constellation and Super Constellation. Success with the L.1049 Super Constellation has lately been most pronounced in the export market. Deliveries have been made to a dozen non-American carriers, and others expect early delivery. Six basic types of civil Constellation are now in service, to be joined shortly by a seventh, the L.1049G with two 500-gallon wing-tip tanks. Typical of the "unstretched" versions is the 749A, which carries up to 60 passengers and is still used by Qantas on one of the longest of over-water hauls—the 2,650-mile leg of the Indian Ocean route from Cocos to Mauritius. With a fuselage 18.4ft longer than the 749A's, the L.1049C Super Constellation accommodates a considerably larger payload—up to 99 passengers plus freight. Its ultimate still-air range (about 5,000 miles) is, contrary to general belief, less than that of the 749A, but it can carry a similar load over longer airline routes.

Designed, like the Seven Seas, specifically for long distances, the projected L.1549 differs from the Douglas concept in that it employs turboprops—6,000 h.p. Pratt and Whitney PT2Fs. Consequently, its period of introduction, possibly on T.W.A.'s network, will be somewhat later. For a 185,000 lb aircraft, the 1549 will have a low capacity-payload—some 18,000 lb, or 90 tourist passengers plus freight. It is intended however, to carry its full load over airline routes of nearly 4,500 miles at a speed of over 400 m.p.h. Total fuel capacity will be some 9,200 Imperial gallons, compared with 8,300 for the Britannia 300 L.R. and 6,550 for the Seven Seas.

The L.1049C Super Constellation — this example was delivered recently to the Colombian airline Avianca—has 3,250 h.p. Wright Turbo-Compound piston engines. A proposed turboprop development, the L.1559, is being suggested to long-range operators.

TRANSPORT AIRCRAFT, 1955 . . .

The Boeing Stratocruiser is very much a mainliner, demanding long runways and having high initial and operating costs. About 50 examples are in trans-oceanic service with three airlines—B.O.A.C., Pan American and Northwest. Though civil production was limited, more than 500 aircraft of the C-97 series have been built for the U.S.A.F. B.O.A.C. have recently bought the United Air Line's fleet of six Stratocruisers and for the next two years or so their transatlantic services will be operated exclusively with these luxurious two-deck transports. That there is a good deal of life left in the type was shown by PanAm's recent decision to spend $1m on a modification programme designed to extend the endurance of their Stratocruisers. Extra wing tanks of some 400 gallons capacity are being installed, increasing the range by 250 miles, and cruising economy is being improved by modifications to the turbo-superchargers of the 3,500 h.p. Wasp Majors. Stratocruisers in transatlantic service with PanAm (carrying only 39 first-class passengers) will thus be enabled to make a higher percentage of non-stop crossings in the eastbound direction; over the Pacific, they are regularly completing the longest of airline stage-lengths—the 3,800 miles between Tokyo and Honolulu. This is made possible by taking advantage of both the extra range of the Stratocruiser and the assistance of high altitude "jet streams" which have, on occasions, resulted in ground speeds of over 450 m.p.h.

Easily the most successful long-range transport aircraft built outside the United States since the war have been the Canadair 4s of B.O.A.C. and Trans-Canada Airlines, which have built up an excellent reputation for reliability and comfort over the past six years. In B.O.A.C. service the Canadair is known as the Argonaut and is used on Commonwealth routes to carry 40 first-class or 56 tourist-class passengers. T.C.A.'s North Stars, as they are called, carry 48 or 57 passengers according to the type of service being flown. Though of similar capacity to the DC-4 the Canadair has a pressurized cabin and wings of the DC-6 type; the most significant distinction, however, is the installation of four Rolls-Royce Merlins.

The H.P. Hermes IV was withdrawn from service when Comets came on to B.O.A.C.'s African routes, but the Corporation has since re-introduced a small fleet of them on tourist services to Dar-es-Salaam and intermediate points. Though originally designed as a 40-seater, the Hermes now usually carries 56 passengers; comfort has not deteriorated, however, to the same extent as in some other tourist conversions. High-density Hermes IVAs are also used by two British independent airlines, Airwork and Britavia, as troopers.

Among operators there is still a wide measure of disagreement as to the future of pure-jet transports. Some feel that turboprop airlines, with their ability to compete with jet transports in terms of elapsed time on many routes, will meet most requirements for the next ten years or more. Others have expressed the view that the jets will always divert traffic from turboprops on competitive routes and, consequently, that the adoption of turboprops will entail a risk of being left behind. Yet a third faction, probably the largest, sees a future for jet and turboprop airliners; B.O.A.C., for example, have a stake in both.

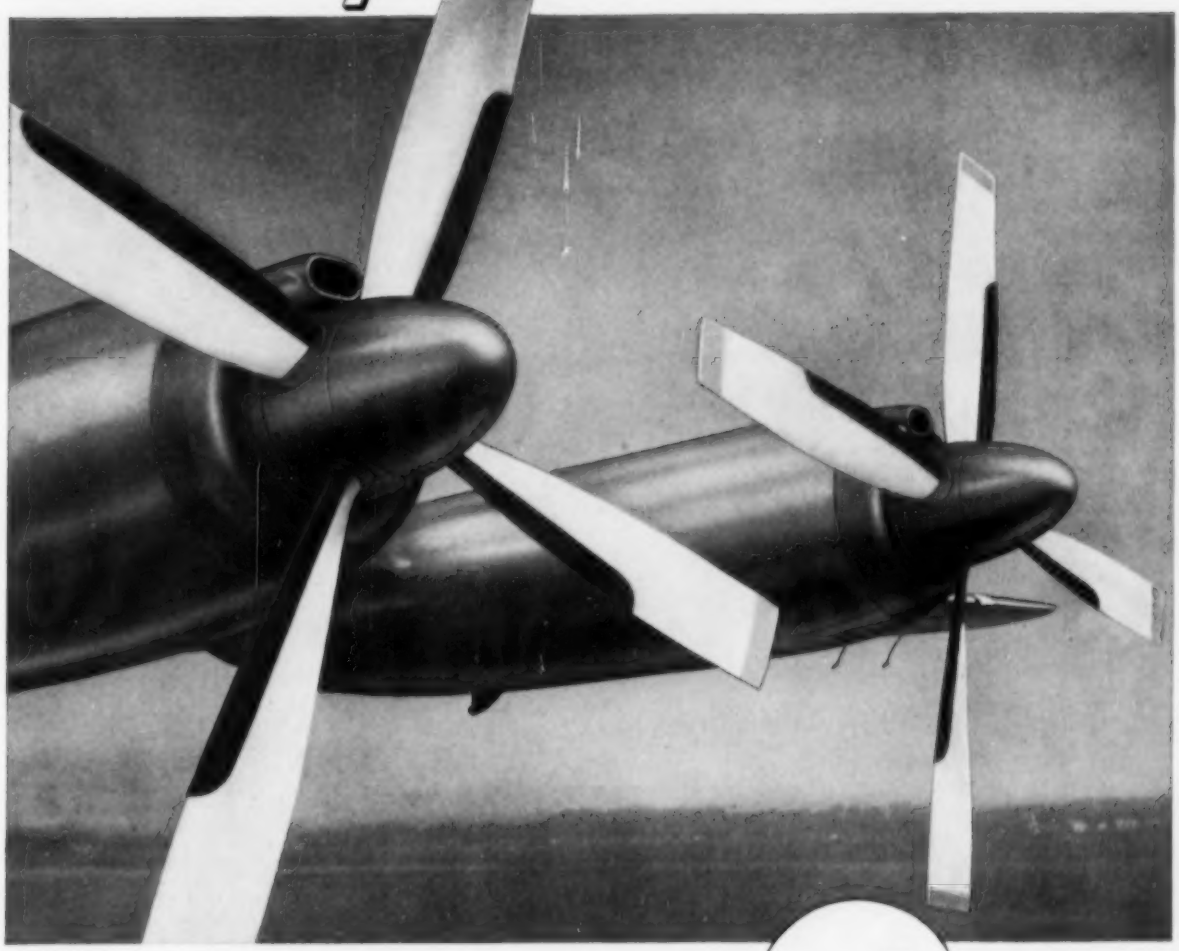
To some extent the final outcome will depend on airlines' decisions over the next few years. There is, however, a powerful influence outside the control of civil operators: military air transport development, which can make available to airlines equipment which they could not afford to order from the drawing board. American and British policy has already generated two potential members of the next generation of airliners—the Boeing 707 and Vickers 1000, respectively.

The prototype Boeing jet transport first flew in May last year. Since then flight trials have gone well and an "initial order" (by British standards a large one) has been placed for a number of KC-135s, tanker versions of the 707, which follows the pattern of Boeing jet bombers in having pod mountings for its four turbojets (10,000 lb thrust Pratt and Whitney JT3Ls). The proposed civil version, named Stratoliner, which, with spares, is expected to cost some £1,850,000, could be fitted with British Olympus or Conway turbojets for which, the makers stated after a recent sales survey, European operators have stated a preference. Like the Comet 3, the Stratoliner would cruise at about 500 m.p.h. at 40,000ft. As suggested by its great cost, however, it is a larger machine, having a weight of 190,000 lb (45,000 lb more than the Comet) and a designed capacity payload of some 15 tons. Its cabin should be able to accommodate over 100 tourist-class passengers, and the limiting stage-length with present power units would probably be in the region of 3,000 miles.

Still larger is the Vickers 1000 jet transport, ordered to give R.A.F. Transport Command the "global mobility" which has so far generally been achieved only by the lavishly equipped U.S. military services. The first example, under construction at Wisley, will be heavier, longer and of wider span than the prototype 707. Its power units will be four Rolls-Royce Conway by-pass turbojets and the first flight is expected late this year. The civil version, designated the V.C.7, will accommodate more than 100 people and will have a speed of 500 m.p.h. or more. It is predicted that the V.C.7. will not only be able to show a profit on the non-stop London to New York crossing but that it will also give economical service on much shorter international routes.

Comparable in size and purpose are (above) the Boeing 707 (four JT3L turbojets of 10,000 lb thrust) and the Vickers 1,000, with four Rolls-Conway by-pass turbojets probably in the 15,000 lb thrust class.

Capital Airlines



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Vickers Viscount 724 for Trans-Canada Air Lines, a 48-seater powered by four Rolls-Royce Dart 506s.

TRANSPORT AIRCRAFT, 1955 . . .

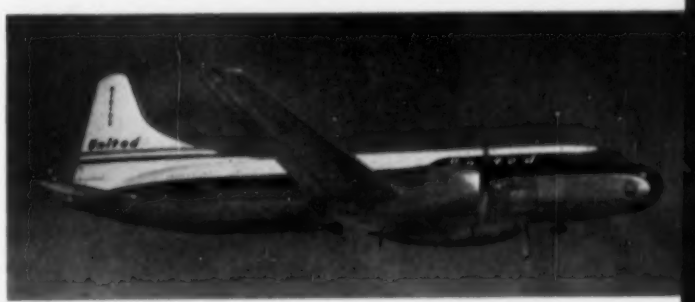
Medium-range Transports. Types which can be considered under this heading vary greatly in capacity, configuration and cost—from the £300,000 fifty-seater with four turboprops to the ex-military piston-engined twin of half the capacity and perhaps one-twenty-fifth of the cost. Broadly speaking, their common task is the connection of cities over distances of 150 to 1,500 miles, often spanning international frontiers and sometimes involving short sea or ocean crossings. It is in the medium-range market that Vickers-Armstrongs have scored a great success for the British aircraft industry with the sale, to date, of nearly 180 Viscounts of which about 50 have been delivered.

Performance figures for the Viscount are best quoted in general terms, since each airline uses a separate model, identified by its own series number, its characteristics being determined by "customer requirements" and the type of Dart fitted. Progressive development of the Rolls-Royce Dart turboprop has, of course, made possible the considerable increase in size of the production Viscounts. Whereas the early prototype Series 630 had 36 seats and a gross weight of less than 40,000 lb, the 48-seat Viscounts now being delivered have a gross weight of 60,000 lb.

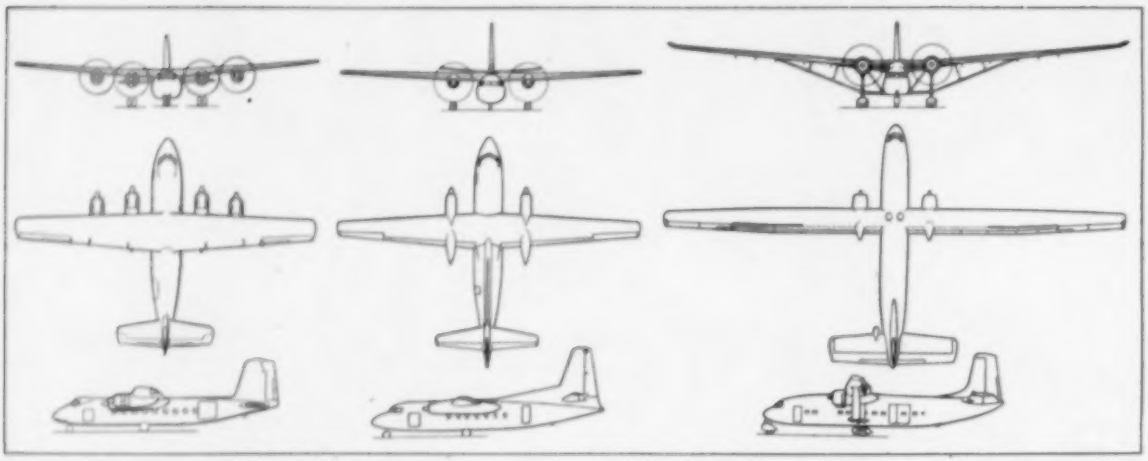
An example of the current-model Viscount is the Series 724 for T.C.A., a 48-seater powered by four Dart 506s each delivering 1,400 s.h.p. plus 365 lb thrust (equivalent to about 1,600 h.p.) at take-off. The aircraft has a cruising speed of 320 m.p.h. at 22,000ft and a still-air range of 1,500 miles with an 11,000 lb payload.

Most of the Viscounts ordered but not yet delivered will be of the 700D family, this designation denoting the installation of Dart 510s, units offering improved performance and economy over the entire operating range. Take-off rating of the Dart 510 is equivalent to 1,700 e.h.p. Viscounts using this engine will carry 230 Imperial gallons more fuel internally than the Series 700s (which have a capacity of 1,720 gallons), effectively postponing the point at which the payload-range curve begins its descent and making the aircraft more attractive to operators of longer routes in the medium-stage band. The Viscount 700D's operational radius can be still further extended by the fitment of two 145-gallon external "slipper" tanks; these give the aircraft a still-air range of 2,410 miles with a 7,450 lb payload.

The latest type of Viscount to be announced is the Series 802, twelve of which have been ordered by B.E.A., with delivery beginning in about 15 months' time. The Viscount Series 800 is designed to translate the extra power of the Dart 510s into payload rather than range; over stages of up to 500 miles it will carry a maximum payload of 14,200 lb, compared with 12,800 lb for the 700D. A 46in fuselage "stretch" will be accompanied by a 65in rearward movement of the aft pressure bulkhead, permitting 14 rows of seats to be installed instead of the customary ten (five-abreast) or 12 (four-abreast). Viscount 800s will thus be able to accommodate up to 70 passengers. Other features include a 5ft by 4ft rectangular forward door for freight loading; adjustable galley and forward bulkhead; folding seats and strengthened cabin floor in the forward part of the aircraft for composite passenger/freight duties. All-up weight will be increased by 2,000 lb.



Standard American medium-range transports, both powered by two 2,400 h.p. Double Wasps, are the Convair-liner 340 (top) and, below it, the Martin 4-0-4. The twin-Avon Caravelle (below) is an ambitious French design due for its first trials this year; from the stage-length viewpoint, it does not fit easily into any of the accepted categories.



Three contrasting contenders for the DC-3 replacement market, drawn to scale (left to right): Handley Page Herald (four Alvis piston engines; span, 95ft; a.u.w., 34,000 lb); Fokker Friendship (two Dart turboprops; span, 95ft; a.u.w., 32,630 lb); Hurel-Dubois H.D.32 (two Twin Wasp piston engines; span, 148ft; a.u.w., 39,672 lb).

TRANSPORT AIRCRAFT, 1955...

The end of Viscount sales is not yet in sight; some observers see a potential market for twice the number sold to date. Vickers-Armstrongs, however, already have a successor on the drawing-board. It is expected to be a 100-seater, capable of at least 400 m.p.h. and powered by four 4,000 h.p. Rolls-Royce R.B.109 turboprops. Pronouncements by B.E.A. suggests that they would prefer it to have a high-wing. While such an aircraft could replace the Viscount on the routes of major airlines, it would not necessarily meet all medium-stage requirements for areas of less dense traffic; it need not be inferred, therefore, that development of the Viscount will end with the Series 800.

Most of the original demand for a pressurized 40-seat short/medium-range airliner was met by the Convair-liner 240 and 340, of which a total of some 350 are in service. External differences between the two aircraft are slight, the model 340 having a 4.5ft fuselage extension and a wing of increased span containing 350 gallons more fuel. The extra length enables the 340 to carry 11 instead of 10 rows of four seats. Cruising speed of both types is in the region of 270 m.p.h., and the range with full payload (9,500-11,500 lb) is in the region of 700 miles. As a result of the Viscount's sales success, orders for the 340 have virtually ceased and its future may be considerably influenced by Napiers re-engining of a Convair 340 with two of their Eland turboprops.

Similar to the Convair in performance and layout, and likewise powered by two 2,400 h.p. P. and W. R-2800s, the Martin 4-0-4 is a familiar part of the American airlines domestic scene. About 100 are in use with Eastern Air Lines and T.W.A. Normal seating capacity is for 44 passengers and average cruising speed is some 250 m.p.h. The Convair and Martin twins feature comparatively narrow fuselages (mean width about 9ft), precluding their conversion to five-abreast seating for tourist or coach services.

None of the American domestic lines has yet chosen Viscounts to replace Martins or Convairs (Capital Airlines have DC-3s, DC-4s and Constellations), and it may be that most are waiting for a four-turboprop design of greater capacity and, possibly, higher cruising speed than the British airliner. American Airlines, the largest operator of all, recently announced that four manufacturers had entered their design competition for a 60-seater cruising at 350-400 m.p.h.

A unique approach towards the medium-stage market is represented by the S.E.210 Caravelle, two prototypes of which are under construction at Toulouse. Capable in standard form of carrying 70 passengers (91 in a tourist layout), the Caravelle is an aircraft of extremely clean design powered by two Rolls-Royce Avons installed one on either side of the rear fuselage. Dependent on the thrust available from its British turbojets, it will have a gross weight of 97,000 lb or 107,300 lb, the former figure being based on a thrust of 10,000 lb per engine and the latter on an output of 11,000 lb. The Caravelle is credited with a payload of nearly 21,000 lb for a 2,000-mile stage-length. The specification on which this interesting machine was based was drawn up by the French Civil Aviation Administration in collaboration with a number of the national airlines of France.

Just as the Martin 4-0-4 remains little more than a name to European readers, so is the Elizabethan-class Ambassador virtually unknown outside Europe. Sole operators are British European Airways, who employ a fleet of 20, primarily on the shorter legs of their international network. The Elizabethan has seating capacity for 47 and a normal maximum cruising speed of 253 m.p.h.; it can operate sectors of up to 470 miles with its full payload of 9,950 lb. From a passenger's point of view the Elizabethan is an uncommonly attractive aeroplane, with its quiet-running Bristol Centaurus engines, its wide, roomy cabin and high wing. The possibility of re-engining with turboprops has been under consideration for some time, the Napier Eland now being a probable choice of power unit.

The Elizabethan is prominent among that small group of post-war transports which, though they failed to sell on a large scale, have given extremely good service.

(Above) B.E.A. Elizabethan, a 47-seater powered by two Bristol Centaurus of 2,625 h.p.; below is a Saab Scandia of VASP (two R-2180 of 1,800 h.p.). The Elizabethan is fully pressurized.

Avro York of Hunting-Clan Air Transport (four 1,610 h.p. R-R. Merlins).

(Above) Hercules-powered Vickers Viking of B.W.I.A.; below, Curtiss C-46s of Loide Aero S.A. (two R-2800).

Another is the Saab Scandia, of which about 20 examples are operated by VASP (Brasil) and S.A.S. Carrying up to 36 passengers at 240 m.p.h., the unpressurized Scandia appeared to meet most of the text-book requirements for a DC-3 replacement when it first appeared in 1946.

Manufacturers in Britain, Holland and France are now making new attempts to solve the DC-3 replacement problem. The most advanced British project is the Handley Page Herald, powered by four Alvis Leonides Major piston engines of 870 h.p., which has already won a measure of success in being ordered "from the drawing-board" by two Australian operators. The Herald, two prototypes of which are under construction, is intended to carry up to 44 passengers or 4½ tons of freight or combinations of both for a stage-length of 350 miles.

A completely different approach to the problem has been taken by the Dutch Fokker concern, who are building two prototypes to Government order (the Herald is a private venture). By a remarkable coincidence, the Friendship has approximately the same all-up weight as the Herald (34,000 lb) and the same span (95ft); like the British aircraft, it is a pressurized, high-wing airliner with single fin and rudder. Take-off power of the Dutch machine will also equal that of the Herald, but it will be derived from two Rolls-Royce Dart turboprops giving a cruising speed in the region of 270 m.p.h. The aircraft is designed to carry a standard load of 28 passengers plus baggage (or 36 in the maximum-density version) over a 300-mile stage. Where the Friendship gains in speed, it loses in payload and take-off performance, the Herald being intended to carry heavier loads from considerably shorter fields.

Though it has less take-off power than either Herald or Friendship, the Hurel Dubois H.D.32 is a bigger aircraft weighing nearly 40,000 lb and is designed to carry a heavier payload—some 5 tons or 42 passengers plus baggage and freight. Powered by the same engines as the DC-3—two 1,200 h.p. Twin Wasps—it promises to better the performance of the classic American transport for purely aerodynamic reasons. The unique high aspect ratio wing is designed to give improved lift without drag penalty; cruising speed of the H.D.32 is similar to that of the DC-3. Two prototypes have already flown and the makers have received military and civil orders for a large number—reported to exceed 100—of production aircraft.

The DC-3 achieved its unparalleled success not by reason of any magical quality but through a combination of virtues, among which may be cited simplicity; reliability; excellent handling characteristics and small-field performance; adequate cruising speed; and economy (partly by reason of its design, but in this respect the low price made possible by military production during the war exerted an artificial influence). The following results achieved by B.E.A. Pionairs (as the Corporation have designated their version of the DC-3) are probably typical for most of the 1,500-odd still in commercial service today. The aircraft is cruised, like most piston-engined transports, on about half the take-off power available—in this case 550-600 h.p. per engine. The average speed is 165 m.p.h. at 6,000ft at a mean weight of 27,000 lb. With a payload of 6,340 lb, 32-seat Pionairs achieve a block speed of 143 m.p.h. over a distance of 340 miles. With payload reduced to 3,420 lb (18 passengers) it can fly a maximum stage of 1,370 miles.

It is pertinent to note that the same airline credited its post-war Vikings, with more powerful Hercules engines, with approximately the same overall payload-range characteristics as the DC-3. The Viking, now no longer in service with B.E.A. though still performing valuable work for a number of other airlines (including some of the main British independent companies), has a higher maximum payload than the DC-3 and cruises some 30 m.p.h. faster. High-

Douglas DC-4 Skymaster (four R-2000 of 1,450 h.p.).

density Vikings carry 36 passengers. A modification to extend the usefulness of the Viking was initiated recently by Eagle Aircraft Services, who have equipped a number of aircraft with a large freight door.

Though the DC-4 was originally designed and used as a long-range transport, current usage justifies its consideration here under the medium-range heading. On most long routes DC-4s have been replaced by pressurized aircraft of later design, but the fact that so many are still used on medium hauls is a tribute to its flexibility. Many DC-4s have been converted to carry 58 passengers or more instead of 40; others are used as freighters carrying loads of up to 8 tons. With its full payload the DC-4 can fly well over 2,000 miles. Its market value—some models are still fetching nearly £200,000—indicates its continuing usefulness.

Once contemporary with the DC-4, but not developed to the same extent, was the twin-engined C-46, some ex-military versions of which are still widely used to carry passengers and freight. Cruising at about 210 m.p.h., the C-46 will carry a 5½ ton payload over stages of 500 miles. Another transport of war-time vintage still used on passenger and freight duties, though on a more restricted scale, is the Merlin-powered York, which approaches

(Right) A colourful example of a classic transport aircraft is this DC-3 of Frontier Airlines. Still the most widely used type of airliner in the world, the DC-3 is powered by 1,200 h.p. Pratt and Whitney Twin Wasps.

Ilyushin Il-12 of Czech Airlines and (below) the newer Il-14 (here shown with Russian military transport markings).

TRANSPORT AIRCRAFT, 1955 . . .

the DC-4 in terms of speed and payload but has a shorter range (some 1,500 miles with full load).

The two water-based aircraft illustrated in this section are representative of an almost vanished race. Both stem from military patrol craft of great endurance, though in their civil role neither is now used on the longer hauls. The Solent carries 42 passengers in great luxury on the holiday routes of Aquila Airways and has a speed of some 200 m.p.h. The Catalina, known in amphibian form as the Canso, cruises at up to 150 m.p.h.; its endurance is prodigious but payload is restricted to about two tons or a maximum of 20 passengers.

Standard equipment of the Russian airline Aeroflot and of some operators in satellite countries is the Ilyushin Il-12, an unpressurized transport of conventional layout. On Soviet domestic routes it normally carries 18 passengers in a seating

D.H. Dove (Gipsy Queen 70, 380 h.p.) in Portuguese East Africa.

Heron 1 of U.A.T. Power-units are 250 h.p. Gipsy Queen 30s.

Marine transports: Aquilla Airways Solent IV (above) and Iceland Airways Canso (amphibian version of the Catalina).

arrangement of surprisingly low density. Cruising speed is a little over 200 m.p.h. and normal maximum stage-length is in the region of 1,000 miles; the amount of wing area suggests that its designer aimed at a rather better small-field performance than is offered by the Il-12's Western counterparts. Essentially similar characteristics are possessed by the Il-14, though this aircraft is of later design and cleaner external appearance; it is used by the Red Air Force but whether it has yet been introduced to service with Aeroflot is not certain.

Short-range Transports. Many and varied are the types of aircraft which can be classified under this title. It embraces the feederliner employed to bring traffic to and from the terminals used by medium- and long-range aircraft as well as the "airliners in miniature" operated to serve purely local needs. Transport helicopters, the ultimate shape of which is not yet clearly defined, are also short-range aircraft—but of a completely different kind, since their economy depends on carrying large passenger loads. Their rôle is thus envisaged as one competitive with surface traffic on dense inter-city routes, extending in length to perhaps 250 miles. Helicopters are also serving in metropolitan areas, usually with the task of linking cities with their outlying airports.

Those illustrated on page 330 cannot in the main be considered as transport vehicles in the same sense as the fixed-wing airliners whose portraits dominate this issue of *Flight*; they do, however, illustrate the tangible results of recent transport-helicopter design philosophy.

On the whole, manufacturers seem to have given the short-range market less attention than others. Very much an exception to the rule is the firm of de Havilland, as indicated by the number of their products depicted here. Still used all over the world, the D.H. Dragon Rapide has been in service since July 1934, when machine No. 6250 was delivered to Switzerland; it is still in use with Swissair. B.E.A. have operated a total of 53 Rapides, though the number in service with the Corporation has now been reduced to eight, the latest of which has flown over 12,000 hours since June 1938. As used by B.E.A. the type is powered by two 203 h.p.

550 h.p. Leonides will power the Twin Pioneer (below).

He had a fuel problem!

The problem of the diplodocus was how to discover substitute fuels when his regular brand started to go off the market. He had about a million years to find the answer but he just wasn't bright enough to figure it out.

Today, people with a fuel problem are more fortunately placed; they can usually be sure of getting the right answer straight-away from ESSO. In fact, if they are really astute they can get the answer before the thing happens instead of after. Designers with the long-term lesson of the diplodocus to stimulate them are tending to consult ESSO about fuelling and lubrication in the initial stages. And, unlike the diplodocus, they have the great advantage of being able at any time to refer to ESSO when faced with the problem of finding alternative fuels, oils or greases.

It pays to consult

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(Right) Heron 2 for Turkish Airlines. The Series 1, with fixed undercarriage, is illustrated on page 328.

TRANSPORT AIRCRAFT, 1955 . . .

Gipsy Queens giving a cruising speed of 120 m.p.h.; it is operated over stage-lengths of 35-200 miles, maximum capacity being for seven passengers.

Like the DC-3, the Rapide has proved difficult to replace. A major proportion of the post-war requirement for a new feeder-liner-cum-executive-transport was met by the D.H. Dove, an eight-seater powered by two Gipsy Queen 70s of 380 h.p. The Dove's cruising speed is 180 m.p.h., and it will carry a 1,500 lb payload for 500 miles. About 500 have been built.

The Heron is essentially a "stretched" Dove with four engines (ungeared, unsupercharged Gipsy Queen 30s of 250 h.p.) and larger dimensions, being capable of carrying up to 17 passengers. The Heron 1 has a fixed undercarriage but the aircraft is also available, in Series 2 form, with retractable wheels, the increased cost and complication of which are offset by improved economy on stages from 500 miles upwards. Approximate cruising speeds for the two versions are 170 m.p.h. (Series 1) and 183 m.p.h. (Series 2). With 14 passengers plus baggage the Heron 2 can operate a stage-length of nearly 700 miles.

Last of a series of well-known and well-liked Lockheed light transports is the Lodestar, a 10/14-seater capable of 220 m.p.h. Typical power-units are 1,200 h.p. Twin Wasps, though other American radials can be fitted. A modernized version, built by Lear, Inc., and known as the Learstar, recently received C.A.A. certification and is to be produced at a rate of two aircraft per month during 1955: most Learstars are destined for use as executive transports.

A machine which, by virtue of its unique combination of desirable features, bids fair to capture a wide market is Scottish Aviation's Twin Pioneer. A logical development of the single-engined Pioneer used with success by the R.A.F., the Twin Pioneer is a twin-Leonides machine intended to lift up to 16 passengers or 3,000 lb of freight from rough strips of less than 250 yd length. The high wing has a liberal area of slats and flaps, and the tail-wheel-type undercarriage has twin wheels throughout; the entrance door is conveniently large and special attention has been paid to problems of servicing in undeveloped regions. The first Twin Pioneer has been built in production jigs and is fast approaching the flight stage; plans are in hand to build a large number, in anticipation of orders. Speed will be in the region of 140 m.p.h.

In certain isolated parts of the world conditions dictate the use of single-engined aircraft on scheduled services. Outstanding among types used under these circumstances is the D.H. Canada Beaver, powered by a 450 h.p. Pratt and Whitney Wasp Junior which can carry from five to seven passengers at a cruising speed of about 140 m.p.h. Beavers operate scheduled services for several airlines, including carriers in Canada, Malaya, Central Africa, South America and the Dutch East Indies. The latest customer is Qantas, who operate three and have ordered a fourth—a float-plane version. Useful features of the Beaver are its ability to operate from 200-yd strips and a range approaching 1,000 miles. A promising future can be foreseen for the Beaver's "big brother," the D.H. Canada Otter, which has a 600 h.p. Wasp and a roomy fuselage accommodating up to 13 passengers. Its range, speed and take-off characteristics approximate to those of the Beaver.

Most successful of civil helicopters introduced to date is the Sikorsky S-55, which has been adopted for airline work of a pioneering character in the United States, Canada, Britain and Belgium. Its most important rôle to date has been the operation of Sabena's international route, on which a fleet of four S-55s (lately increased to six) have carried over 27,000 passengers. Sabena's S-55s normally carry seven passengers at speeds approaching 100 m.p.h. The two Westland-built machines of this type recently purchased by B.E.A., for the operation of a scheduled service between London's city centre and its main airport, will be fitted with amphibious gear for emergency landings, reducing the passenger capacity to five. It is reported that Sabena are considering the placing of an order for the S-58, a larger development of the S-55 with a 1,640 h.p. engine and with capacity for 20 passengers.

Both the airlines mentioned above have declared their interest in the twin-engined Sikorsky S-56; prototypes have been flying in military form for some months. A projected civil variant might carry 35 passengers at 120-140 m.p.h. In B.E.A.'s case, the interest centres on the possibility of a Westland-built version powered by British turboprops.

Largest of all transport helicopters is the Piasecki Transporter, of which the proposed civil version is said to accommodate—in high density form—as many as 72 passengers. Like the S-56, it has so far appeared only as a military prototype. A cruising speed of 150 m.p.h. is foreseen.

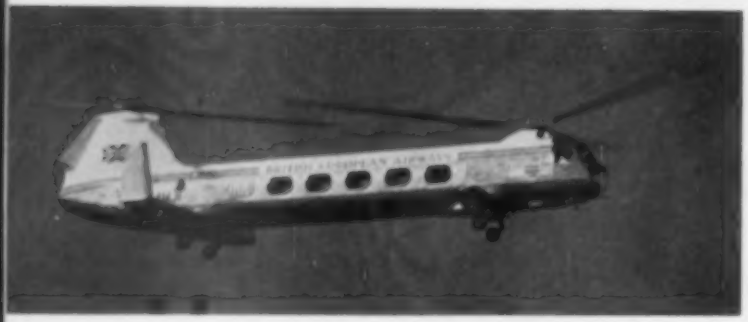
Another American design in which B.E.A. have expressed interest, according to the Corporation's latest annual report, is "a projected 50-passenger Douglas helicopter powered with British turbine engines"—a formidable-sounding combination.

Lockheed Lodestar (1,200 h.p. Twin Wasps).

D.H. Beaver of Central African Airways (450 h.p. Wasp Junior).

D.H. Otter demonstrator (600 h.p. Wasp).

(Above) Bristol 171 (Alvis Leonides of 550 h.p.). (Left) D. H. Rapide (Gipsy Queen 2 engines with constant-speed airscrews) converted for Noon and Pearce, Ltd., of Nairobi. (Below left) Bristol 173. (Below) Model of Fairey Rotodyne (two Napier Eland).



TRANSPORT AIRCRAFT, 1955 . . .

Though the twin-rotor Bristol 173 was originally intended for service with B.E.A. in its present piston-engined form and with stub wings to unload the rotor and increase cruising speed, development of this type is at present being conducted primarily with military applications in mind. However, long term civil developments with the twin-rotor configuration, using, perhaps, gas turbine power, are planned. Meanwhile the B.E.A. Helicopter Unit are amassing much preliminary information with three four-seat Bristol 171s, whose duties include the operation of a scheduled service between London Airport and Southampton.

B.E.A. and other airlines are watching with close interest development of the Fairey Rotodyne, a prototype of which has been ordered by the Ministry of Supply. Powered by two 3,150 h.p. Napier Eland turboprops, the Rotodyne will use conventional airscrews to give a cruising speed of at least 150 m.p.h. Vertical lift for take-off and descent will be provided by the tip-jet-driven single rotor, of 90ft diameter. Maximum payload will be 11,000 lb, consisting of 40-50 passengers or freight (including vehicles, which will be loaded through "clamshell" rear doors). Still-air range of the Rotodyne should be nearly 290 miles. The manufacturers have published the following indications of its capabilities on typical inter-city routes: London-Paris, 88 min; London-Amsterdam, 92 min; London-Jersey, 77 min; London-Manchester, 68 min.

Freight Aircraft. During the past few years air freight has not developed at the same pace as passenger traffic, a fact which is generally attributed to the absence of aircraft capable of carrying big loads at rates well below those charged for passengers. The growing tendency to equip newer types of aircraft with larger cargo compartments and loading doors represents one attempt to remedy this situation. Ultimately, however, the solution is believed to lie in increased use of aircraft specifically designed for freighting. Manufacturers have lately shown increased interest in such aircraft.

Most promising of recent developments in the sphere of long-range freighting was the appearance of the U.S.A.F.'s Lockheed C-130A Hercules, powered by four 3,750 h.p. Allison T56 turboprops. Performance details are still restricted, but it may be noted that the fuselage is pressurized for high-altitude, long-range flight, and that it is furnished with large forward and rear doors for simultaneous loading and unloading. The Hercules is expected to carry payloads of up to 20 tons.

Meanwhile, the potentialities of the long-range all-freight aeroplane are being displayed in daily service by two important adaptations of long-established passenger transports. As shown in these

Quartet of American-designed helicopters: above are the Sikorsky S-56 (left) and Piasecki Transporter; below are (left) the Westland-Sikorsky WS-55 and (right) the Sikorsky S-58.

Pressurized freighters: a Douglas DC-6A Liftmaster of K.L.M. and, below, a Seaboard and Western Lockheed 1049D Super Constellation.

illustrations, both have large fore and aft loading doors. The DC-6A Liftmaster is used by Slick Airways, American Airlines (the A.A. versions are unique in being windowless), PanAm and K.L.M. Already in regular service on transatlantic routes, the type will be introduced later this year on the service inaugurated on March 1st by Airwork Atlantic. Capable of a cruising speed of 300 m.p.h., the Liftmaster has a capacity payload of 14 short tons, and its floor is stressed to take single shipments of up to 10 tons; dimensions of the loading doors are 10ft 4in by 6ft 6in (forward) and 7ft 7in by 5ft 7in (rear).

Lockheed's 1049D Super Constellation freighter also has a normal cruising speed of 300 m.p.h. and the capacity payload is quoted as 16½ short tons. As yet, the sole operators are Seaboard and Western Airlines, who recently took delivery of four such aircraft. One of the Seaboard Super Connies flew from Hamburg to Idlewild recently with a record load of 27,458 lb of general merchandize. A typical load for the 83ft-long pressurized cargo compartment is quoted by the makers as "20 racehorses in individual stalls with water, hay and feed." Dimensions of the main door are 9ft 4in long by 6ft 2in high.

Most widely used of short-range cargo aircraft is the Bristol 170 Freighter, which can carry a payload of five short tons for 850 miles at 166 m.p.h. Freighters are used in many parts of the world for both cargo and passenger work, normal seating capacity being for 44 people. Known as the Superfreighter, the Bristol 170 Mk 32 is a long-nosed version developed specifically for the short-range vehicle ferry services of Silver City Airways; this version can carry three cars and 20 passengers.

The Blackburn Universal, in production for the R.A.F. as the Beverley, is designed to lift an unprecedented payload of 22 tons from grass fields only 1,000 yd long. Huge rear loading doors give access to the main hold, which is completely unobstructed and measures 10ft by 10ft by 40ft. The quoted payload includes 40 passengers, who can be accommodated in the tail-boom of the aircraft. Use of the main hold for passengers would increase the Universal's total seating capacity to upwards of 100.

Though its large rear loading doors qualify it for mention as a freighter, the Breguet Deux Ponts (known by Air France, its operators, as the Provence) is used primarily for short- and medium-haul passenger services, carrying up to 106 on two decks. The payload is 16 tons.

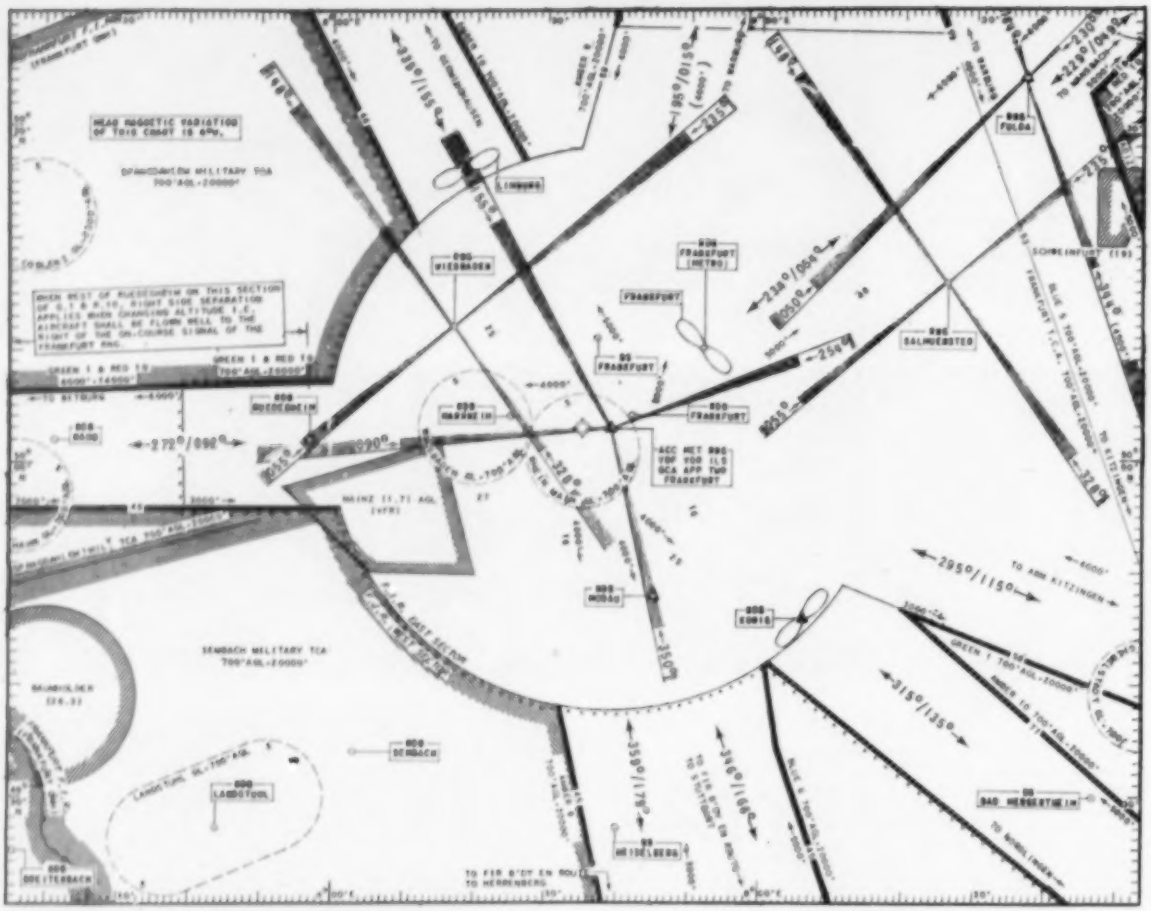
The Hercules-powered Nord Noratlas is being built in some numbers, mainly for the French Air Force; the aircraft is now available to civil operators, and the French independent airline U.A.T. have recently bought two for their African routes. The capacious, rear-loaded cabin of the Noratlas will accommodate 40 passengers or 7½ short tons of freight. Capable of cruising at 200 m.p.h., the Noratlas will carry 6 tons for 750 miles.

(*A table of data for civil aircraft appears on p. 337.*)

Lockheed C-130A Hercules (military) prototype (Allison T56).

Bristol 170 Mk 31E (Hercules 734).

First production-type Blackburn Beverley transport, powered by four Centaurus 173s. The civil version will be known as the Universal.



AIRLINE NAVIGATION

A Summary of Facilities and Procedures

EFFICIENT navigation for the airliner means safety, operation to schedule in almost all weathers, and hence profit. Position and course to the destination, or to a source of help, must be known at all times and must be susceptible to positive supervision from the ground.

The crew of an airliner must themselves know at all times where they are, how far they are from a waypoint or destination, how long it will take them to get there and how much fuel they will need to do so. With a view to achieving these objectives, airline operators install equipment suitable for using a variety of facilities which exist on the ground; and, according to the type of aircraft used, each flight is planned in detail to achieve a given stage distance with adequate reserves of fuel, yet with the maximum payload. Since payload depends upon the type of aircraft and the route involved more than upon the method of flying that route, this article concentrates on the navigational rather than on the flight-planning aspect.

Airline navigation resolves itself into facilities, methods and procedures. Their distribution and use can best be introduced by describing the equipment carried, for example, by a Pan American Airways DC-6, and how this is used during an Atlantic crossing. Both the equipment and its use are typical of airline practice, though of course there are many small variations from company to company.

The Pan American DC-6, then, carries duplicate V.H.F. communications sets giving at least 50 different channels, H.F R/T. receiver and transmitter (again duplicated), a Loran receiver, two M.F. receivers with A.D.F. loops and cockpit indicators, two V.O.R. receivers with two cockpit indicators, duplicated I.L.S. equipment, Sperry Zero Reader, Sperry A.12 autopilot and a radio altimeter.

Of these the Loran receiver, the V.O.R. receivers and the I.L.S. equipment, are used principally in conjunction with their related ground installations. The M.F. receivers, on the other hand, are approximately equivalent to normal medium-frequency receivers and can be used for a variety of purposes. Without the loop facility they can pick up ordinary radio broadcasts, special meteorological information transmitted by various agencies at certain times, and such of the navigation aids as do not require special receivers. These latter aids include medium-frequency radio ranges, and Consol.

Meanwhile the automatic loops tied to each receiver are used to obtain a bearing, relative to the aircraft's fore-and-aft axis, of the station transmitting (when within range), whether this be a normal broadcast (B.B.C. Light Programme, Droitwich, for example), or a particular M.F. radio facility specially sited for navigational purposes.

It is, of course, also possible to arrange for an M.F. navigational beacon to transmit information verbally or in code so that it can be used for two purposes at once. A.D.F. is useful because of its flexibility, but for various reasons does not supply all the airliner's navigational requirements. First, it is not a long-range aid, and secondly it is not sufficiently accurate and free from static interference in certain atmospheric conditions and geographical locations; thirdly, identification of a beacon is not always free from ambiguity.

There is a further navigational aid called V.A.R. (visual aural range) which is basically a development of I.L.S. and which can therefore be picked up with the I.L.S. receiver. V.A.R. consists of two beams transmitted by a ground station approximately at right angles, one being visual, i.e., fed into the I.L.S. cross-pointer meter, and the other aural and fed as a tone signal into the pilot's earphones. There are a number of these ranges on the Continent, particularly as track guides for the Berlin air corridor, but V.A.R. is not an accepted standard I.C.A.O. aid. It is also possible to feed a V.O.R. radial bearing signal into the I.L.S. vertical cross-pointer needle to facilitate instrument course-holding.

The normally accepted radio range is an M.F. aid, picked up

The chart on the opposite page shows the facilities for the Frankfurt terminal area. The airways are marked with their bearings, the ranges, non-directional beacons (NDB), fan markers (in this case bone-shaped), and the facilities at Frankfurt itself. The latter include ACC (Area Control Centre), MET (meteorological information), RNG (radio range), VDF, V.H.F./D.F. and V.O.R. APP and TWR denote that the aircraft should call Frankfurt Approach or Tower on the frequencies listed on an accompanying table.

The lines on the edge of the shaded range legs denote the "N" sector and the shaded outline of the airways show the presence of danger areas. These latter are necessary because of the presence of military airfields, each with its non-directional beacon. The black triangles show the reporting points, here all marked with non-directional beacons. The heights of the various danger and control areas are also shown.

with the M.F. receivers, which takes the form of aural signals (morse As and Ns) transmitted in four lobes so arranged that, at the intersection of the various lobes, the As and Ns merge to give a continuous steady tone in the earphones. These equi-signal areas are so adjusted in azimuth that they form a track guide in a certain direction, to indicate the position of an airway. If used as a terminal airfield marshalling aid the equi-signal legs are usually at right angles. These two arrangements can be seen on the chart reproduced opposite.

Where ranges are located with the equi-signal tracks following the airway, an aircraft will fly outbound along a certain leg until it reaches a point where it meets the inbound leg of another range. In order to show when the intersection is reached, a beacon known as a fan marker is placed there. This usually transmits on 75 Mc/s and is picked up by an independent marker beacon receiver in the aircraft. It causes a light to flash in the cockpit, and when this occurs the pilot tunes his M.F. receiver to the new range frequency and follows the new equi-signal track. Along these airways there are reporting points, some voluntary, but most compulsory, over which the pilot calls the air traffic control centre in whose area he is flying (either by H.F./R.T. or V.H.F.) to report his position. He will then be cleared to follow the next stage in his planned route at a height which will give him the necessary safe vertical separation from other aircraft in the same area. Radio range is still widely used on the North American continent and wartime installations are still in operation in Europe, but it survives as a primary system mainly in the United Kingdom.

In the U.S.A. the airways which previously relied on radio ranges have now mostly changed over to V.O.R., with which there is complete coverage. The beacons associated with V.O.R., however, are not necessarily situated on the airways themselves and are often slightly to one side of the required airway track. To facilitate airways flying by V.O.R. therefore, a system of "victor airways" has been instituted, whereby flight clearance is given either along the true airway track or along an alternative track passing directly over the nearest V.O.R. stations to it. This means that an airliner fitted with V.O.R. receivers (and almost all of them are) can fly directly outbound along a V.O.R. radial until it reaches a point where that radial intersects a given radial from another station. The receiver is then tuned to this and course suitably altered.

V.O.R. (V.H.F. omni-range) consists of a station transmitting in the V.H.F. band a continuous series of signals in every direction. These signals cause a needle on a dial in the cockpit to indicate the bearing of the station relative to the aircraft's fore-and-aft axis, with much the same result as the A.D.F. The indicator is often called the O.B.I. (omni-bearing indicator). As in the case of A.D.F., the signals from two V.O.R. receivers are often fed to two needles on the same dial, so that cross-bearings can be taken to obtain a position fix.

In accordance with an I.C.A.O. decision some time ago, a standard short-range navigation system was adopted and accepted by all member nations. This offered the advantage that all airlines could thereafter hope to rely on the installation in all relevant traffic areas and so be able to operate without an extensive array of diversified airborne aids which would involve unnecessary expense. The system adopted was sponsored by the U.S.A. and called V.O.R./D.M.E. It was to consist of networks of V.O.R. stations, suitably distributed to cover airways and supported by D.M.E. (distance-measuring equipment) beacons. Thus an aircraft's position could be fixed by measuring the bearing and distrnce from a given V.O.R./D.M.E. facility. V.O.R. has worked well and is extensively installed in the U.S.A. In Europe there are as yet not very many, though more are being added, particularly in Italy and the Balkans.

D.M.E. is also extensively used in the U.S.A. and Australia, but in Europe there are only experimental installations and results so far have not come up to expectations. Equipment in England (used principally by B.O.A.C.'s Comets) has been of the traditional Rebecca/Eureka radar interrogator/responder beacon type, working on the 200 Mc/s band. This band, however, is already part of the T.V. domain and not likely to remain free for much longer.

Navigation systems of the above types give position fixes by providing information on bearing and distance from a given point. They are known as theta (azimuth)/R (distance) systems and are distinct from so-called "area coverage" systems. These latter transmit waves to form a hyperbolic lattice pattern which can be picked up in the aircraft by special receivers whose indications are interpreted with the aid of charts to give a position fix. They mostly work on the M.F. band, using groups of stations deployed in "master" and "slave" patterns.

A system of this type developed during the war is called Gee, and has a range of some 300 miles; both range and accuracy are affected by various ground and atmospheric characteristics. It is not used by the airlines. A long-range development of Gee was called Loran by the Americans and, again using master and slave stations this time on the L.F. band, it gives fixes at ranges up to 2,000 miles. Accuracy and range are again affected by terrain and atmospheric conditions. In the standard reference publications for all navigation aids, the patterns of accuracy and night effect are given for each of these aids.

A further system is Consol, which was originally a German military aid used during the war, discovered by the Allies and thereafter used by them also. As stated above, it can be picked up on the normal M.F. receiver in the aircraft. Consol consists of a long-range electrically rotated beacon which transmits its call-sign every minute or so, followed by a steady note for 30 sec on which the pilot can take a normal A.D.F. bearing. This is followed by a series of dots and dashes which the pilot counts as they are received. By knowing his approximate bearing from the station, and then finding the exact radial near this bearing on the Consol chart where the combination of dots and dashes occurs, he will find the bearing of the station.

Loran and Consol, having a longer range than either V.O.R. or normal M.F. facilities, are used as an aid during oversea crossings, particularly over the Atlantic. The Eastern Atlantic seaboard is covered by a Consol network and some Loran, with Consol stations at Seville (Spain), Lugo (Northern Spain), Quimper (Brittany), Bush Mills (Northern Ireland) and Stavanger (Norway). The western seaboard has an equivalent system of Loran, and both almost meet in mid-Atlantic.

An airliner flying, for example from Idlewild (New York) to Shannon, will use first Loran and then Consol as they are available. In addition a constant check on position and track will be kept with the traditional astro-navigation methods, using a sextant and tables. During the crossing the airliner will report its position to the Atlantic control stations every hour by either W/T. or H.F./R.T.—mostly by the latter—the control stations being at New York, London, Gander, Keflavik and Santa Maria (Azores). These stations, using 15 to 20 frequencies, are in their turn in communication with each other, so that the aircraft's position can be reported to the agents of the airline company concerned on either side of the ocean. In the case of Pan American, the New York office watches the aircraft up to 30 deg W, where the London office takes it over.

In addition to astro navigation, D.R., Loran and Consol, the aircraft can make use of the facilities afforded by the ocean weather-ships. These are distributed over the North Atlantic as shown in the accompanying map and have radar sets with a range of about 90 miles. They also have V.H.F. for communication and direction finding and non-directional M.F. beacons on which the aircraft can take a bearing with its A.D.F. Communication can be established between ship and aircraft, weather and wind information passed, and position-fixing carried out. These weather ships drift and do not maintain their position with the accuracy of a land beacon. A special lattice system is therefore printed on the navigation chart, from which the ship can tell the aircraft where she lies in relation to her specified position.

When leaving Idlewild the airliner is given permission before it takes off to fly out to sea through a particular control corridor in the A.D.I.Z. (Air Defence Identification Zones which surround most areas of direct U.S. influence) and told to report at the required point. Thereafter it follows its flight plan, and makes use of all the aids and plotting methods available for position fixing.

It is Pan American practice to carry a captain and two first officers (all pilots) one of whom will also be a trained navigator. For the crossing he will use only one chart, a 1 : 5,000,000-scale Mercator conformal projection covering the whole distance from New York to London, and giving just such information as he is liable to need. The only topographical features are coastlines and large rivers. In addition the chart will show A.D.I.Z. boundaries, Loran lattices and Consol bearing roses, weather-ship positions (with their position-error grids) and finally the latitude and longitude lines. The principal colour on the chart is green, which while remaining visible in artificial light, does not unduly obtrude itself over the pencil markings of the navigator's position plots. The track is marked as a rhumb line (straight) and all fixes recorded on it as they are taken.

If there is a possibility, in view of weather and load conditions, that the flight can continue non-stop right to London, the track will be marked straight from the last A.D.I.Z. reporting point to a point on the south leg of the Shannon radio range, over the sea,

AIRLINE NAVIGATION...

known as South Shannon. From another point well out in the Atlantic a branch is drawn direct to Shannon airport. Either of these tracks can be followed—to Shannon South if fuel consumption plotted against time shows a possibility of reaching London direct, or direct to Shannon if not.

If the captain flies to South Shannon he must then decide whether to continue or turn north to Shannon. He must have fuel for two hours' holding there or, if he decides he can continue non-stop to London and declares it as his alternative, he needs fuel for only one hour's holding there. Usually because of fuel he has to choose Shannon, and flies there according to the instructions received from Shannon control, using the southern range leg and beacons.

His final leg to London will be a short one and this time the flight will be entirely within the airway control. He will file his flight plan and obtain a clearance along the airway at a given height and time, and by using the information provided for him on his airways and facilities chart he will find his way to London without map reading.

This latter art is nowadays reserved principally for emergencies.

B.E.A. aircraft, which ply principally on short-range routes, carry a complete set of 1 : 500,000-scale maps of the route flown, but these are generally used only in case of radio failure, since the occasions when a flight can conveniently be made using the traditional visual plotting are rare. Good weather is required for it, and the airlines no longer wait for this. Furthermore, the airliner now flies at much greater heights than, for instance, before the war, and accurate visual plotting is difficult from high altitude, even if patches or layers of cloud do not intervene. Finally, a beacon or range station is a better indication of exact location than a visual pinpoint, and it also gives steering information. Most short range (under 800 miles, over land) flights are in any case made under direct control from air traffic control centres, and instructions are mostly given to coincide with radio facilities.

B.E.A. principally make use of A.D.F. dual installations in the aircraft, which allow them to use the M.F. facilities existing in Europe, including Consol in the Bay of Biscay. Otherwise, in Southern Europe, there are a number of V.H.F./D.F. stations able to give bearings or fixes. It is also probable that V.O.R. will be installed in some aircraft during this year. In addition to this, B.E.A. Viscounts carry the Decca navigator. This system allows the aircraft's position to be fixed by plotting on a special chart the co-ordinates shown on three meters (Deccometers). The meters themselves produce the readings by resolving the signals sent out as a continuous wave-pattern lattice from a Decca chain. The Decca flight Log with which Viscounts are also equipped gives a continuous indication of position and track made good on a special chart like that on a barograph. There are several Decca chains—three in Britain, and one each in France, Germany and Denmark. Decca is a medium-range system suitable for use at all altitudes and new chains will soon cover Sweden, the Orkneys, Southern France and possibly Spain and Italy.

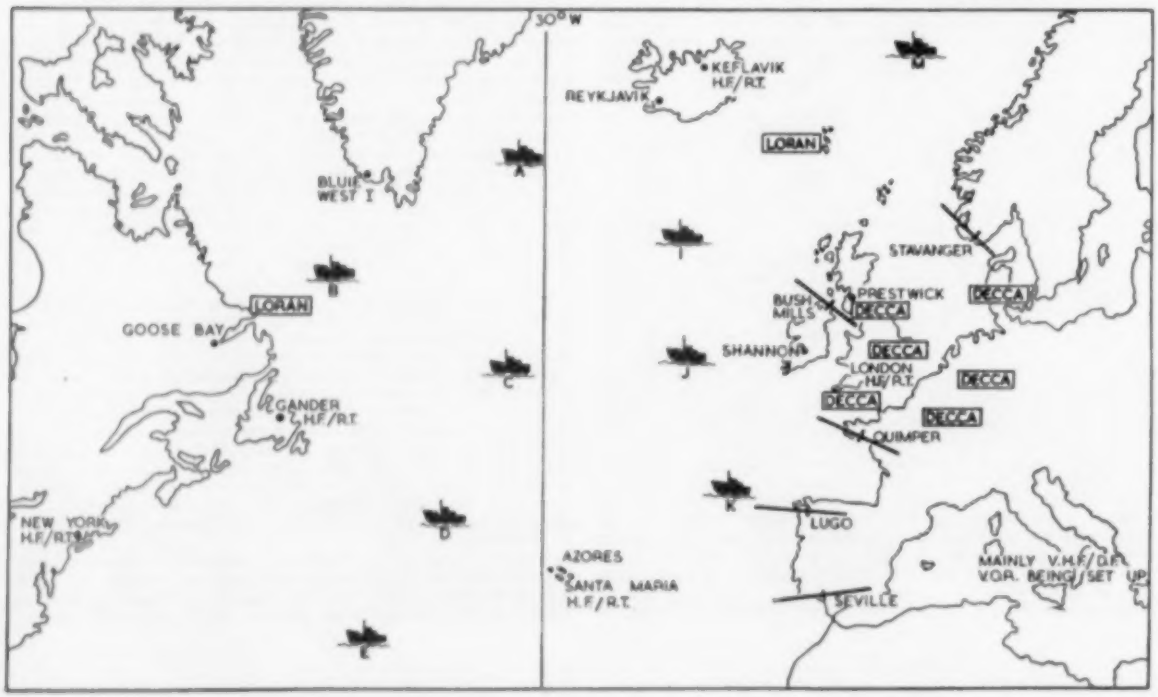
The transatlantic flight described above shows how the process of navigation is carried out where there are no specific airways. Once it is clear of the American A.D.I.Z.s the airliner is free to fly more or less where it finds the best conditions and it can make use of the pressure-pattern flying technique. This means that for a given route the shortest way to a destination may not necessarily be the quickest one, because of wind conditions. Considerable advantage may be obtained by following a line of constant barometric pressure, thus taking advantage of favourable wind pattern on one or other side of the straightest track. To accomplish this, the weather map is studied and a suitable pressure track selected, and the aircraft is then navigated to follow the line, where it will find a tailwind. There may, however, be a discrepancy between forecast and actual conditions, and this can be checked with a radio altimeter, whose readings can be compared with those of the pressure altimeter. This is the purpose of the DC-6's radio altimeter.

In most areas of the world, particularly in Europe and America, all air movements are routed along airways, and a large proportion of the radio navigation facilities are positioned as track aids for them. The pilot flying along these airways must obviously know exactly where they lie, which facilities are available and when, and how, he should make use of them. For control purposes he must also know whom to call, and on what frequency, in order to obtain instructions.

All this information is issued in the form of printed charts and tables, and an example—for the Frankfurt terminal area—is shown on page 332. This particular specimen is taken from the official Aerad Flight Guide for Europe and the Middle East, where it is accompanied by a table giving all the radio frequencies used in connection with it. Most companies do not, for specific routes, need all the information thus given. They prepare their own charts, usually covering a complete route between two cities, including such topographical details as they wish to note, airways locations and bearings, reporting points and the location of all the required beacons and broadcast stations and radio ranges or similar aids. On the same chart they will usually include the frequencies and call-signs next to each facility. Although some of the Aerad charts appear impossibly complicated, they are intended as complete reference charts from which the relevant facilities can be taken as needed. It is, for example, the practice for some airline pilots to draw the necessary radio facilities on a postcard before take-off, and to use this information exclusively during a given flight. The position and bearings of one or two radio ranges and their related fan marker positions may be all that is required. The pilot files his flight plan with traffic control and then is given clearance along the route at certain heights.

For arrival at the destination there is another series of charts which will show him the particular facilities and procedures in use at the airfield itself. These again may appear very compli-

This map shows the distribution of medium- and long-range navigation aids over the Atlantic and western Europe, excluding V.H.F./D.F. stations and beacons and ranges. The straight lines at Stavanger, Bush Mills, Quimper, Lugo, and Seville mark Consol stations.



cated, but regular airline crews familiarize themselves thoroughly with the procedures before they begin to take passengers to that airfield. The control tower will also pass to them the necessary instructions.

Aircraft are rarely allowed to "stack" (the term is descriptive enough to need no explanation) actually over an airfield, and neighbouring beacons and ranges are designated as holding points. Pilots fly a certain type of pattern over them at a given height, and, as the aircraft ahead land, those still waiting are told to move on by stages till they themselves can come in to land. If an approach is unsuccessful the aircraft must overshoot, return to a holding point and wait its turn for a second attempt. It is for this reason, among others, that airliners have to arrive over their destination with enough fuel for one or two hours' holding. The length of the stipulated hold-off reserve is not an indication that delays are common, but rather a measure of safety.

The ground organization devoted to traffic control is large and expensive, but very necessary for safety when so many aircraft fly regularly in certain areas. Traffic over the Atlantic must soon reach a level where some form of direct control will be required. This will present its own particular problems, for over such a range cruising height will greatly affect the aircraft's range and also its payload. If an airliner is told just before take-off, for instance, that it must wait for 30 min and then fly at a height somewhat lower than that for which the flight has been planned, it may no longer have the fuel needed to reach its destination. This will particularly apply to jet transports. Precise position fixing will also be difficult far out to sea, and it seems likely that some quite new type of control will be required, and that this in its turn will have a considerable effect on navigation.

Finally, brief mention must be made of a possible change in the international standard short-range navigation aid as approved by I.C.A.O. This is at present V.O.R./D.M.E. The American C.A.A. has recently, however, approved a projected aid called TACAN which is thought to be a R/Theta aid similar to V.O.R., but working in the 1,000 Mc/s band (U.H.F.). It seems likely, from past experience, that this aid may be adopted by I.C.A.O., in which case the airlines would be faced with the need for a major change in equipment.

While V.O.R./D.M.E., particularly D.M.E., was in any case not extensively exploited in Europe, it would take some years to introduce TACAN, but for the present C.A.A. has decided to withdraw D.M.E. from June this year and guarantee V.O.R. only until 1965.

Being a position-fixing as well as a track aid, TACAN would be a great improvement over most present systems and, due to its high frequency, would be far freer from static interference than present M.F. facilities. But it is a "line-of-sight" aid, which cannot be used for low-level flights and some other system might in addition be required to cover low levels, e.g., where helicopters will operate.

Whatever the position may be in regard to a new standard aid, it is certain that the networks of non-directional beacons and V.H.F. fixers, which are now the principal aids in southern Europe and many other parts of the world, will have to be replaced by more modern equipment. V.O.R. was a great step in overcoming the disadvantages inherent in the use of M.F. but it is in itself incomplete as an aid. What is required is all-altitude, static-free positive position-fixing equipment, whose ground installations are inexpensive and universally distributed, and whose airborne components are light and compact. Range is not so important, except over sea, so long as sufficient distribution of stations is achieved.

C. M. L.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Sperrin and Valiant

IN your article "Background to the Sperrin" (January 21st) it was stated that this aircraft " . . . was Britain's first wholly new type of bomber—apart from the Vickers Windsor and the smaller Canberra—to appear in the ten years from the beginning of World War II."

The Sperrin made its first flight in August 1951—three months after the prototype flight of the Vickers Valiant. To the Valiant, therefore, should be accorded the honour of being the first British four-jet bomber to fly. Both the Valiant and the Sperrin were demonstrated at Farnborough in 1951.

Weybridge, Surrey. CHARLES GARDNER.
Vickers-Armstrongs (Aircraft), Ltd.

[Certainly the Valiant flew first; but the Short machine was designed and ordered two years earlier, and—to bring forward delivery dates in the event of large-scale orders—production jigs were made first and then used for manufacture of the prototypes. The Sperrin programme was also hindered by the company's move from Kent to Belfast and by a prolonged industrial dispute. —Ed.]

Flight Test Observers

WITH reference to Mr. Sowrey's suggestion for a Flight Test Observers' Association, I should like to express full support for this scheme. It is a splendid idea, and the desirability of such a "non-union" organization must have been felt by flight observers everywhere for some time past. Full marks to Mr. Sowrey for starting the ball rolling.

I feel sure that his suggestion will receive the backing it deserves from all who are eligible for membership of a "Guild of British Flight Test Observers"; he may certainly count on every member of the group that I myself represent.

Hemel Hempstead, Herts. R. H. WILLIAMS.

MAY I, through your correspondence column, make a few comments on Mr. W. Sowrey's letter (February 25th) concerning the forming of a "Flight Test Observers' Guild"?

One has the impression that Mr. Sowrey is very new in the field of aviation and in writing his letter was thinking more of the glory of being a flight test observer than any other aspect of the business.

Flight test observers have been in existence for a considerable number of years and have got along very well without a "guild" to date—not that one in the future would be a hindrance. Your correspondent suggests that its objects should be:—

(1) *To ensure that observers have the proper safety equipment.* The answer to this one is that aircrew should not fly without the necessary equipment; and my experience has shown that, regardless of the fact that this is available, it is not used to its fullest advantage.

(2) *To help dependants of disabled or deceased observers.* Is Mr. Sowrey flying without any insurance coverage by his firm?

(3) *"Informing the public on matters concerning flight test observers."* No comment!

(4) *"Exchanging general ideas and opinions."* What would the directors of certain firms think of this one, in view of the competitive field of aviation, and not forgetting those who rely on internal security?

I am not saying that Mr. Sowrey is wrong; but I think he, and anyone who agrees with him, should think again before entering on such a venture.

Bournemouth, Hants. FLIGHT OBSERVER (10 years).

FORTHCOMING EVENTS

Mar. 11. Helicopter Association: "Helicopter Maintenance," by J. H. Willins, A.M.I.C.E.
Mar. 11. British Gliding Association: Ball, Londonderry House.
Mar. 11. Institute of the Aeronautical Sciences: National flight propulsion meeting, Cleveland.
Mar. 14. Royal Society of Arts: "The Mechanical Properties of Metals—(1) Tensile Properties," by Prof. Hugh Ford, D.Sc., Ph.D.
Mar. 15. R.Ae.S. Section lecture: "Production of Large Forgings," by C. Smith, F.I.M., and J. Crowther, M.Sc., F.I.M.
Mar. 16. R.Ae.C.: Dinner for King's Cup winners.
Mar. 17. R.Ae.S.: Eighth Louis Blériot Lecture, "Making Aeroplanes Independent of Runways," by M. Georges Hereil.
Mar. 18. Institute of Navigation: "Problems in Space Travel," by Dr. J. G. Porter.
Mar. 18. Institute of Transport: Annual Dinner.
Mar. 19. British Interplanetary Society (Manchester branch): "Rocket Engineering," by Prof. A. D. Baxter, M.Eng., M.I.Mech.E., F.R.Ae.S.
Mar. 19. British Interplanetary Society (Leeds and Sheffield branch): "The Moon," by M. C. Metcalf.
Mar. 19. Surrey Flying Club: Opening of new club-house, Croydon.
Mar. 21. Royal Society of Arts: "The Mechanical Properties of Metals—(2) Creep," by Prof. E. N. da C. Andrade, D.Sc., Ph.D., LL.D., F.R.S.
Mar. 23. R.Ae.C.: Annual general meeting.
Mar. 24. R.Ae.S. Main lecture: "Analogue Computing Applied to Aeronautical Problems," by K. V. Diprose, B.A.
Mar. 25. College of Aeronautics Senior Common Room Society: Annual dinner.

R.Ae.S. Branch Fixtures (to March 24th):—

Mar. 12, *Birmingham*, Annual dinner. Mar. 14, *Halton*, "Cabin Pressurization," by F. W. Michael. Mar. 15, *Manchester*, "Helicopters," by C. S. Hislop; *Belfast*, "Aerial Photography," by Charles Brown. Mar. 16, *Southampton*, "The A.R.A. Wind Tunnel," by R. Hills. Mar. 18, *Birmingham*, "Trends in Development of Aircraft Electrical and Starting Systems," by R. H. Woodall. Mar. 21, *Halton*, Branch night; *Henlow*, Film, "Hall's Angels"; *Yeovil*, "Production Problems on Helicopters," by D. C. Collins. Mar. 22, *Bristol*, "Some Problems of Bomber Design," by D. Keith-Lucas. Mar. 23, *Cheltenham*, "Some Problems of Bomber Design," by D. Keith-Lucas; *Luton*, Annual general meeting. Mar. 24, *Isle of Wight*, Branch prize lectures.

AIRWORTHINESS . . . (Continued from page 320)

margin following engine failure. A typical example of the drift-down technique is the Convair CV-340 on routes over the Alps. This aircraft cannot cross the Alps with one engine out, but, with both engines operating, it can fly high enough to permit a safe drift-down in the event of failure.

The curves on page 318 of a hypothetical airliner show the type of flight path which would be followed in the event of engine failure in the critical sector of a particular route. Curves of this nature are required to establish the maximum weight at the entry to the critical sector and the minimum planned altitude at which the aircraft must fly in order to complete a safe drift-down to an appropriate airfield. Calculations of this type are quite standardized for modern transports where the route requires. A margin for error is necessary, for a pilot may be flying above cloud at the moment of failure and he may not know his precise position, which could lead to a wrong decision—such as turning back when he should have gone on.

Climb gradient, which was ignored in the original American code, is now accepted as one of the principal criteria of margin of performance. If a machine like a DC-7 were being designed today, the designer would be presented with different choices at the same weight and temperature according to whether the aircraft was to comply with the C.A.A. code or B.C.A.Rs., and the resulting aircraft would have different degrees of safety. As an indication of the difference between the two codes the diagram of rate of climb plotted against airspeed (foot of p. 319) shows the divergence of the lines of best rate and best gradient. All other things being equal, the speed optimum for the best gradient is preferable to the brochure speed for maximum rate of climb; but other factors such as cooling may demand a higher airspeed. For example, the Constellation normally has a mandatory fast climb on account of cooling troubles. Although this diagram emphasizes the greater safety inherent in choosing gradient as the criteria, the U.S.-designed aircraft is not inherently "unsafe", and could be made to meet a rational code by slight modification—such as an *inter alia* alteration in the flap settings.

Mean Performance

Another concept which has only recently become appreciated is that of fleet mean performance—an essential in the calculation of the achieved performance of fleets of airliners actually in service. The flight manual was previously based on figures measured on a new and polished aircraft submitted on a certain date. As the aircraft develops, performance tests may be repeated at higher weights and these latter tests may be more carefully done and may give uncorrelated results. It is now usual to undertake a periodic check on the performance of aircraft actually in service; an uneconomic alternative is to insert a "cushion" to allow for unassessed deterioration. Extra aerials, for example, may eventually spoil the stall or aerodynamic behaviour of a previously clean aircraft.

The power actually developed by the engines may also vary, and a fleet mean power is therefore taken as half the sum of the powers of typical new and old engines. At the same time, account has to be taken of the accessory power being extracted, for this is naturally deducted from that applied to the airscrew, and can vary considerably over the life of an aircraft and between different points of a given route. Incidentally, many British prototypes are full of experimental equipment and other abnormalities, and so quite by accident the original performance testing may be done on an aircraft representative of its successors in service. Another point worth noting is that renewal testing teaches airline pilots what their aircraft should do and precisely how it should be flown.

The modern code of British performance requirements is based upon fair argument. This is considered a distinct advantage over empirical codes which virtually cannot be discussed at all. Close co-ordination is necessary between all the parties concerned and considerable pains have to be taken on what might be termed the ironmongery of systems and safety devices.

For example, any system of auto-feathering may have inherent dangers, and, in fact, simple defects in such equipment have led to a number of serious accidents with American transports. British designers have mainly preferred a system of automatic pitch coarsening, from which full power can be regained at once in the event of error. An alternative arrangement is the use of an automatic warning light which comes on to the pilot's panel if failure is signalled from one engine; the circuit also selects this engine for feathering by a single button on the pilot's control wheel. This system allows the pilot to decide whether or not to feather and permits him to do so without removing his hands from the controls. The Ambassador and Bristol Freighters 31 and 32 all have auto-coarsening and selective auto-feathering of the type described. The Viscount has an additional fine-pitch stop which prevents the airscrew from assuming a pitch so fine as to invalidate the established minimum control speed; upon deflection of the undercarriage legs, however, this stop is removed for braking purposes and also for starting the turboprops with the minimum airscrew drag.

The altitude at which maximum power is available from the engine has a considerable bearing on take-off and engine-out performance. DC-3 power units have had increasing full-throttle heights from 3,000 to 5,000ft and today there is scarcely a single American transport with a full-throttle height less than the latter figure, in order to meet the V_S^2 requirement. After World War II, some British transports had much lower full-throttle heights and would have had to reduce weight unnecessarily if operated from low-altitude airfields under C.A.A. rules. (This emphasizes the great advantage of an engine like the Bristol BE.25.)

Vertical tail-area is another parameter with a great effect on airworthiness. Even with its triple fins, the York has a high minimum-control speed, whereas the Tudor has a better engine-out performance. The Britannia also has to have a very large fin, whereas the Comet, with its close-in thrust lines, needs a relatively small surface.

The Hermes was designed with the idea of meeting the V_S^2 law and, although at the C. of A. the weight had grown considerably, the Wat curve (mx. wt., alt. and temp.) was adequate and with the take-off flap-setting reduced from 40 to 20 deg in the Hermes 4A, the engine-out climb is good. (Use of 40 deg-flap, however, gave better field-length.) Such aircraft as the Apollo and Viscount were designed to meet the original I.C.A.O. V_S^2 rule, and this and/or commonsense dictated the power-loading, flaps and control system. In the event, the Viscount 700 design was settled before B.C.A.R.s were formulated but the Vickers designers knew what was coming and this aircraft is now fully certificated in both Britain and America.

One of the main shortcomings of printed airworthiness codes at the moment is in the take-off and landing of modern high-speed transports. These aircraft have low drag and great weight, and consequently are "slippery" in the air. Such aircraft may be heavily dependent on wheel brakes and sensitive to runway condition. As a result, the extreme landing distances may vary more widely than before. The proposed new British rational landing requirements consider all types of landings with one or two engines out, in a cross-wind or on a wet surface or with any other type of undesirable combination. One invariable result of performance measurement is that landing distance is extremely sensitive, i.e., to reduce the distance by, say, 10 per cent, one has to reduce weight by a very considerable amount.

Under the old code, which assumed maximum braking and a dry runway, field length stayed constant and safety decreased, as braking power and test-pilot technique improved to counter the progressive increase in approach speed. With the rational requirements, anti-skid devices, and other means for achieving short landings, can be fully assessed against safety; this was not possible under C.A.A. rules. The new code also brings out the desirability of having high air-drag and also controllable drag or thrust on the approach to minimize landing with excess speed.

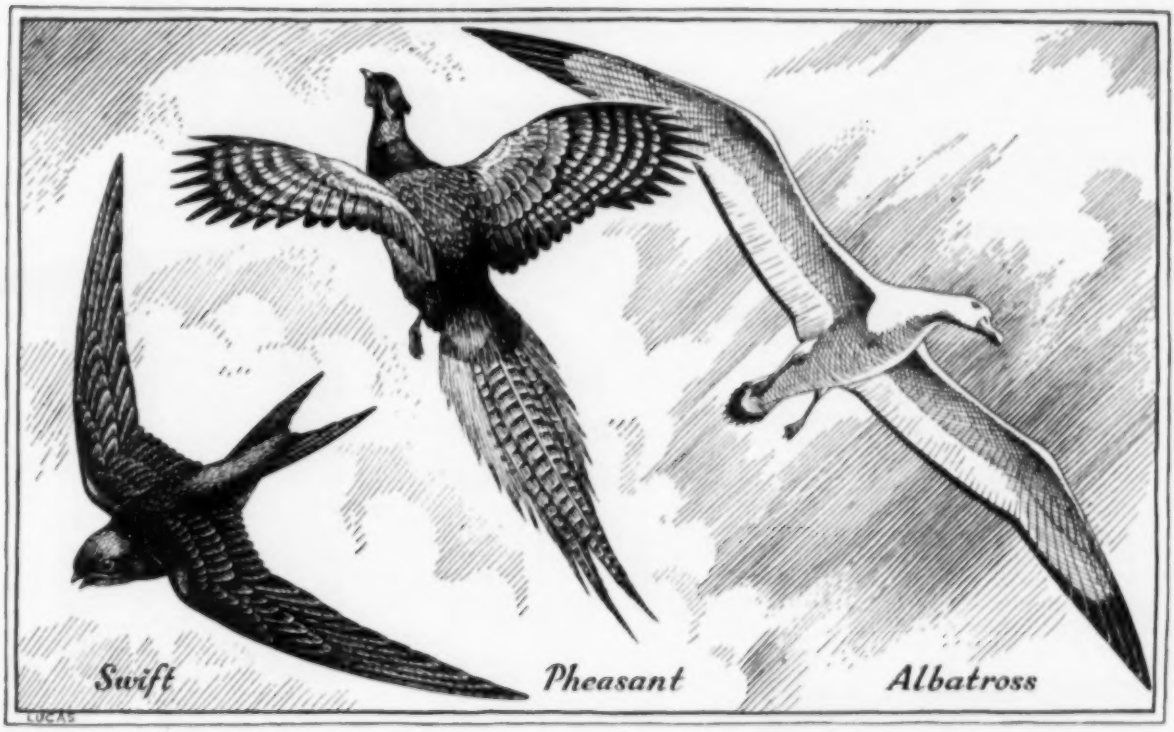
A sketch on page 319 shows the tremendous variation in landing distance produced by varying pilot-technique. Particularly on a dry runway, it is seen that by far the shortest landings can be made by dropping the nose wheels on to the ground immediately, retracting the flaps to put all the weight on to the wheels, and then applying full braking. Normally, however, it is possible to keep the nose fairly high, with full flap, and conserve the wheel brakes as much as possible. It is certain that future turbojet transports will embody some form of reverse thrust and, when such devices are fitted, the rational code will enable their effect to be assessed. Today, this equipment is one of many things which are in a state of flux and, under B.C.A.R.s, it is possible to discuss the matter dispassionately and arrive at what is probably a good solution bearing in mind the state of the art.

The Human Aspect

Elementary statistics show that an aircraft has to be exceptionally dangerous before it suffers a noticeably high accident rate. A high proportion of present accidents (as distinct from reportable incidents) are ascribed to pilot error, and rational performance requirements are coming in hand-in-hand with a re-appraisal of this factor. This is not to suggest that captains will be able to fly less strictly, but a fairer assessment should be possible of what a normal pilot can be expected to do allowing for the usual random drop in pilot performance from the mean value. This tends to lead one into dangerous waters, and to point out that it is better for an airline's prestige to say that "Captain X made an error" rather than that the procedure under which he was flying was at fault. Accident investigation requires real co-operation from all aircrew trade unions, conducted on an informed but not partisan basis. Pilots' unions are also keenly interested in such duties as ferrying aircraft home on three engines after a failure overseas. In such flying the likelihood of an incident is normally much greater than the standard 10^{-5} ; on the other hand, if crews were given a bonus for such work it might be less unpopular.

W. T. G.

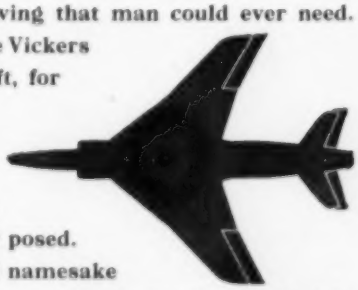
Problems of flight



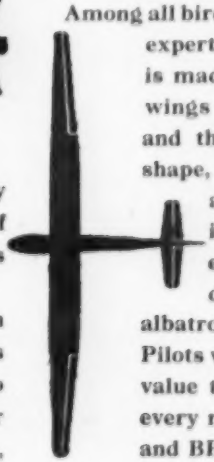
WING SHAPES

Nature is a master of aerodynamics. She has devised, for the infinitely varied needs of her flying creatures, every wing that man could ever need.

The wing of the Vickers Supermarine Swift, for example, solves problems that new engines and new enemies have only recently posed. The Swift's small namesake needs speed as pre-eminently, for it lives largely on the tiny, almost invisibly fast-flying gnats of river-side and meadow. For this bird as for this aircraft swept-back wings are the answer.



The pheasant has very different needs. It lives in woodland, feeding and breeding on the ground. Its safety depends on its steep "rocketing" climb. So its wings are short for speed, broad and arched for maximum lift. Man's solution of the same problem, in carrier-based aircraft, is the same: the Hawker Sea Hawk needs the pheasant's short take-off and steep climb; so it has the pheasant's short broad wing shape. One other striking example among thousands is the albatross. Among all birds the most expert glider, it is made so by its wings — narrow, and the longest of any bird. This wing shape, too, has been taken over by man to answer the special problems of soaring flight. The wings of the sail plane exemplify exactly the same aerodynamic principles as those of the albatross, and to the same end.



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TRANSPORT AIRCRAFT - 1955

Leading Particulars of the Major Types, Listed in Order of All-up Weight

THIS table presents, in compact form, basic data for all the principal transport aircraft now in operation or under construction. Unusually, the aircraft have been arranged in order of weight, since this permits more ready comparison to be made between generally similar types of aircraft. On the other hand, too-direct comparison should not be attempted; as noted at the foot of the page, the basis upon which each figure is given may vary between one machine and the next (this is particularly true of range), and no account has been taken of date of design or of the current market value.

Type	Take-off weight lb	Power units			Span ft in	Length ft in	Wing loading lb/sq ft	Capacity payload lb	No. of seats	Typical performance				Field length ft
		No.	Type	Output per unit*						Distance st. miles	Load lb	Speed m.p.h.	Height ft	
Vickers V.C.7	200,000	4	R-R. Conway	—	140 0	146 0	—	—	130	—	—	—	—	—
Boeing 707	190,000	4	P. and W. JT3L	10,000 t	130 0	127 10	79.1	30,000	80-130	3,000	30,000	500	40,000	8,000
Lockheed 1549	185,000	4	P. and W. PT2F	6,000	150 0	124 4	100	18,000	60-90	4,400	18,000	410	30,000	6,500
Bristol 175-300LR	165,000	4	Proteus 755	4,150	142 3½	124 3	80.3	30,000	65-101	4,500	30,000	350	30,000	6,500
Bristol 175-250LR	165,000	4	Proteus 755	4,150	142 3½	124 3	80.3	36,700	65-87	3,740	36,500	350	30,000	6,500
Bristol 175-300	155,000	4	Proteus 755	4,150	142 3½	124 3	75.4	30,000	65-101	3,800	30,000	350	30,000	5,750
Bristol 175-250	155,000	4	Proteus 755	4,150	142 3½	124 3	75.4	36,700	65-87	3,050	36,500	350	30,000	5,750
Bristol 175-100	150,000	4	Proteus 705	3,780	142 3½	114 0	73	25,000	63-92	4,100	25,000	340	30,000	4,780
D.H. Comet 3	150,000	4	Avon 521	10,000 t	115 0	111 0	72	19,500	58-76	2,600	19,500	500	40,000	—
Boeing 377	145,800	4	P. and W. R-4360	3,500	141 3	110 4	82.4	23,640	52-90	2,600	23,000	300	25,000	7,100
Douglas DC-7C	139,000	4	Wright R-3350-EA1	3,400	127 6	112 3	85	20,130	62-100	4,400	16,740	343	15,000	7,000
Blackburn Universal	135,000	4	Centaurus 673	2,850	162 0	99 2	46.4	54,170	100-132	200	46,300	180	8,000	3,990
Lockheed 1049C	133,000	4	Wright C18-DA1	3,250	123 0	113 7	80	25,000	63-99	3,000	25,000	300	18,000	6,100
Douglas DC-7B	126,000	4	Wright R-3350-DA1	3,250	117 6	108 11	86.1	22,870	64-95	3,500	15,000	350	23,500	5,750
Douglas DC-7	122,000	4	Wright R-3350-DA1	3,250	117 6	108 11	83.5	20,353	64-95	3,050	17,225	350	23,500	6,050
D.H. Comet 2	120,000	4	R-R. Avon 502	7,350 t	115 0	96 1	59	13,000	44	2,600	13,000	500	40,000	7,200
Breguet Provence	113,700	4	P. and W. R-2800	2,400	141 0	94 11	48.4	32,400	106	870	24,250	223	8,000	5,600
Lockheed 749A	107,000	4	Wright C18-BD1	2,500	123 0	95 2	64.8	18,000	49-65	2,400	18,000	280	15,000	4,775
Douglas DC-6A	107,000	4	P. and W. R-2800	2,500	117 6	105 7	73.1	28,100	Freight	2,750	28,000	280	18,000	6,150
Douglas DC-6B	107,000	4	P. and W. R-2800	2,500	117 6	105 7	73.1	19,200	56-82	3,000	19,000	290	18,000	6,350
S.E. Caravelle	99,200	2	Avon 521	10,000 t	112 6	103 4	63	20,900	70-91	1,473	20,900	492	40,000	5,900
Douglas DC-6	97,200	4	P. and W. R-2800	2,400	117 6	100 7	66.4	16,800	56-76	3,500	16,000	280	18,000	5,400
Lockheed 049	96,000	4	Wright C18-BA3	2,200	123 0	95 2	58.2	19,000	43-81	3,450	10,000	270	12,000	4,500
H.P. Hermes IVA	86,000	4	Hercules 773	2,125	113 0	96 10	61.1	15,340	40-60	1,600	15,000	230	13,000	5,120
Canadair 4	82,000	4	R-R. Merlin 724	1,760	117 6	93 5	55.1	12,000	40-57	2,600	12,000	270	18,000	5,200
Douglas DC-4	73,000	4	P. and W. R-2000	1,450	117 6	93 10	49.9	18,000	40-60	2,100	17,000	200	8,000	5,050
Avro York	68,000	4	R-R. Merlin 500	1,610	102 0	78 0	52.4	11,000	35	1,300	11,000	210	8,000	5,000
Vickers Viscount 802	62,000	4	R-R. Dart 510	1,697	94 0	85 0	64.3	14,200	53-70	1,060	14,200	318	20,000	5,640
Vickers Viscount 700D	60,000	4	R-R. Dart 510	1,697	94 0	81 2	62.3	12,800	40-59	1,450	12,800	320	20,000	5,190
Vickers Viscount 700	57,000	4	R-R. Dart 505	1,547	94 0	81 2	59.1	12,700	40-59	1,400	12,700	304	20,000	5,265
D.H. Ambassador	55,000	2	Centaurus 661	2,600	115 0	82 0	43.7	9,950	40-47	470	9,950	253	15,000	4,720
Convair CV-340	47,000	2	R-2800-CB16	2,400	105 4	79 2	50.8	12,700	44	750	11,200	268	15,000	4,500
Curtiss C-46	45,000	2	R-2800-71	2,000	108 0	76 4	35	12,200	40-56	600	11,000	210	10,000	3,800
Martin 4-0-4	44,900	2	R-2800-CB16	2,400	93 3	74 7	52	9,900	44	900	9,000	255	15,000	4,360
Bristol 170 Mk 31	44,000	2	Hercules 734	2,000	108 0	68 4	29.5	12,000	40	850	10,000	166	5,000	3,675
Nord 2501	43,120	2	Hercules 739	2,040	106 7	71 8	40	15,070	45	700	12,500	190	9,840	2,700
Convair CV-240	41,790	2	R-2800-CB16	2,400	91 9	74 8	51	9,460	40	650	9,000	274	10,000	4,420
S.O.80P Bretagne	41,665	2	R-2800-B43	2,000	88 2	62 2	45	9,920	43	650	9,400	225	15,000	5,725
Hurel-Dubois HD-32	39,672	2	R-1830-92	1,200	148 7	76 4	36.8	11,705	44	600	11,705	165	10,000	3,600
Il-12	38,000	2	ASH-82FNV	1,775	104 0	69 11	—	—	32	750	8,000	200	5,000	2,100
Saab Scandia	35,280	2	R-2180-E1	1,800	91 10	69 11	38.2	9,350	32	900	7,000	230	10,000	3,940
H.P. Herald	34,000	4	Leonides Major	870	95 0	70 3	38	10,395	44	1,417	6,930	200	10,000	2,200
Vickers Viking	34,000	2	Hercules 634	1,690	99 3	65 4	38.5	6,940	36	160	6,940	204	6,000	4,800
Fokker Friendship	32,630	2	Dart 510	1,690	95 0	73 0	45.3	9,535	24-36	500	7,000	266	20,000	3,800
Convair Canso	28,000	2	R-1830-92	1,200	104 0	68 6	20	4,500	20	900	4,000	150	10,000	2,000(L) 3,200(S)
Douglas DC-3	28,000	2	R-1830-92	1,200	95 0	64 5	28.3	6,340	21-36	350	6,340	170	6,000	2,680
A.T. Accountant	24,000	2	Dart 510	1,690	77 6	57 6	40	7,520	22-36	500	6,000	275	15,000	—
Lockheed Lodestar	21,500	2	R-1830	1,200	65 6	49 10	33.6	—	10-14	130	4,500	220	10,000	—
H.P. Marathon	18,250	4	D.H. Queen 70	340	65 0	52 1	36.7	5,036	22	720	4,172	158	5,000	3,500
Yak-16	14,100	2	ASH-21	750	65 7	47 6	—	3,000	10	600	3,000	170	5,000	1,600
S.A. Twin Pioneer	13,500	2	Leonides 503/8	550	76 6	45 1	19	3,000	16	500	3,000	124	5,000	675
D.H. Heron 2	13,000	4	D.H. Queen 30 Mk 2	250	71 6	48 6	26	3,054	14-17	690	2,926	183	8,000	2,700
Percival Prince 3	11,000	2	Leonides 502/4	550	56 0	42 10	30.1	1,800	8	902	1,500	159	10,000	2,700
Beech D-18	8,750	2	R-985-14B	450	47 8	34 2	25	—	7	970	1,280	210	10,000	—
D.H. Dove 1	8,500	2	D.H. Queen 70	340	57 0	39 6	26.3	—	11	490	1,672	179	8,000	2,400
D.H.C. Otter	7,600	1	R-1340-S3H1-G	600	58 0	42 0	18.7	2,200	14	1,065	2,200	139	10,000	980
D.H. Rapide	5,550	2	D.H. Queen 6	205	48 0	34 6	17.4	1,200	7	213	800	117	2,000	1,600
D.H.C. Beaver	5,100	1	P. and W. R-985	450	48 0	30 3	20.4	1,500	5-7	880	1,500	137	10,000	880

*The output per engine is the maximum rated sea-level power which can be used for take-off. In piston engines it is brake horse-power, in turboprops it is total equivalent horse-power and in turbojets it is pounds thrust (denoted by the suffix "t").

General notes: the figures in the last column represent the I.C.A.O. balanced field length for the type, and are generally of the order of twice the actual ground run during an all-engines take-off; where a certificated weight varies according to the country of operation, the British figure (if appropriate) is given; where the aircraft has not yet been certificated, the normal all-up weight is given and not the maximum (design limit) weight; the typical performances are, of course, selected from a wide curve of possible values, and the DC-3, for example, is frequently used on stages considerably longer than the distance given. It should be stressed that these performances are based upon the best available data and yet should not be used as a basis for comparison between different aircraft—for example, the distances given for the Britannias are all still-air ranges, whereas those for the Comets are stage-lengths (the figures are generally stage lengths, but these data are unavailable for some aircraft).

Notes on specific aircraft: Vickers Armstrongs V.C.7 take-off weight is estimated; Boeing 707 data apply to present prototype only; de Havilland Comet 2 and 3 data are also not necessarily representative of what these aircraft will achieve when fully certificated; Viscount 700 data refers to present B.E.A. Series 701, and some 700-series machines have, or will have, the Dart 506, of higher efficiency, and an increased take-off weight of 58,500 lb; Curtiss C-46 weight is that for passenger operation, or 3,000 lb less than the certificated weight for freight; the figures in the last column for the Canso amphibian refer to land and sea operation; the Prince and Dove shown in this table are the types now in general use although both have now been superseded by developments with increased all-up weight (Prince 5 and Dove 5 and (6); landplane Otter and Beaver data are given.

FOR AIRPORT SAFETY

Modern Crash-and-fire Rescue Technique: Some Typical Equipment Reviewed

YEAR by year, civil aircraft operations become progressively safer, as a result of improved engine, airframe and component design, the steady development of new navigational aids and communications, and the planning and control of air corridors and zones. Nevertheless, accidents still can, and do, happen; this is a fact that has to be faced, and action taken accordingly in the hope of preventing, or at any rate reducing, avoidable injury or loss of life. As insurance against *en route* emergencies there are such measures as airborne fire-detection and fire-fighting equipment, the provision of life-jackets and rafts, the use of rearward-facing seats (yet to be widely adopted), and the mandatory incorporation of efficient emergency exits in the fuselage design. Crew-discipline, too, can be a valuable factor, as the actions of stewardesses (in particular) have demonstrated in more than one instance.

It is not with *en route* accidents, however, that we are concerned here, but with those which may occur at or near airfields during take-off and landing.* In such cases, while several of the precautions mentioned above still hold good, a new factor enters, namely, the fire-extinguishing and rescue services provided at the airfield. Briefly to review some typical equipment available for such services is the purpose of this article.

Licensed airfields are required to provide and maintain fire and rescue equipment to an approved scale, and at M.T.C.A. airfields the Ministry itself is responsible for the service.

Irrespective of the kind of equipment employed, speed in bringing it into action is, obviously, of paramount importance. Modern fire tenders, therefore, are designed for quick starting, lively acceleration, and the ability to travel fast over rough ground. Their equipment, too, is so arranged that it may be brought into use immediately the vehicle has reached the scene of the crash—sometimes even before it has stopped moving.

As the typical severity of a crash fire is almost always due to petrol—or, in the case of some jet aircraft, kerosine—in probably large quantities, water has never been in favour as an extinguishing agent (though, as has been authoritatively stated,† water sprays can be used to advantage for protecting rescue and fire-fighting personnel from radiated heat, while in some instances straight jets may be used to "sweep" fuel-spills from hazardous areas or to maintain a rescue lane free from flame). The most commonly used agents for dealing with aircraft fires are carbon dioxide (CO_2) and foam, often employed simultaneously. Quite recently, chlorobromomethane (CH_2ClBr, commonly contracted to "C.B." or "C.B.M.") has been introduced in this country, with strong claims as to its effectiveness. Two other well known extinguishing agents, carbon tetrachloride and methyl bromide, are usually employed in hand extinguishers only.

The instant the fire has been brought sufficiently under control, or in the fortunate event of fire not having broken out at all, the rescue personnel will move in to extricate the occupants, using where necessary such tools as shears, crowbars, grab-hooks and possibly—as shown later in this article—a new power saw. If there has been a fire, it is usual to continue the application of foam in order to prevent re-ignition of free fuel by any small residual fires. One or more members of the team will probably wear heat-resisting clothing, giving protection to the head as well as to the body.

All but the smaller airfield fire tenders are usually provided with a considerable variety of equipment, for they may at any time be called upon to deal with fires quite unconnected with aircraft crashes—e.g., in hangars or airport buildings. It is even possible, of course, that they may encounter a formidable combination of both circumstances—a conflagration arising from an aircraft striking a building.

Typical of modern airfield crash-tender design is a vehicle—illustrated below—lately constructed to the order of overseas airport authorities by the old-established Greenwich firm of **Merryweather and Sons, Ltd.** Drive from a powerful six-cylinder petrol engine is taken to both rear axles of the six-wheel chassis.

In the body of the vehicle is a 600 gallon water tank, and another container carries foam-making compound. The main engine-driven fire pump is permanently connected with the water tank in such a way as to allow water alone to be discharged or to permit the water to be pumped through mechanical foam generators. Coils of canvas hose are carried for delivery of water, and for foam delivery there is a locker on each side of the vehicle carrying a 100ft length of 2½in canvas hose permanently connected to the foam generators and terminating in a copper nozzle—or, to use the fire engineer's term, branchpipe.

CO_2 is carried in six 60 lb cylinders accommodated in two batteries of three in recesses at the rear of the machine. The gas is fed to two reels each carrying 100ft of high-pressure hose terminating in distributor nozzles. The reels are carried beneath the crew compartment, in which there is a panel giving complete control of both foam and CO_2 supplies.

There is also provision for a "first-aid" water stream from 180ft of hose carried on a reel at the rear of the vehicle; this water is supplied by a secondary pump driven from a take-off on the main pump gearbox. "First-aid" foam equipment is also carried, in the form of six two-gallon "Fire Suds" hand extinguishers. Additionally, the appliance is fitted to carry full rescue equipment, together with a stretcher, casualty first-aid kit and two searchlights.

Other Merryweather fire-fighting equipment of interest to airfield operators includes "Karbono" CO_2 extinguishers; one particularly useful arrangement consists of five cylinders, with 120ft hose reel and 8ft applicator, mounted on a two-wheeled trailer for towing behind a motor vehicle.

Briefly referred to in the introduction to this article, chlorobromomethane is a fire-extinguishing agent of comparatively recent introduction and exceptional speed of action. It was demonstrated at Bovingdon Airfield in the spring of last year (see *Flight*, May 28th, 1954) by the **General Fire Appliance Co., Ltd.**, of London, S.W.1—and since that time the firm has been engaged on a development programme with various forms of C.B. equipment.

The company provide C.B. for the Kronenburg fire tenders manufactured in Holland for NATO airfields. These vehicles are of the "monitor" type, i.e., they carry a universally mounted nozzle on the roof of the cab. From this monitor, and from "ground sweeps" (i.e., spray valves low down on the front of the vehicle) and hose lines, a fire can be attacked with foam, foam-fog (finely atomized foam), water-fog, or water alone. Carried in an air-pressurized container, the C.B. is fed through a hose-reel and emerges through a special applicator as a compact cone of

*I.C.A.O. Accident Digest No. 5 shows that of 43 investigated accidents which occurred in 1953, 24 were on, or in the vicinity of, airfields.

†by E. J. C. Wilbiams, Principal Fire Service Officer, Air Ministry, in a paper before the Institution of Fire Engineers.

The Merryweather airfield fire tender referred to above. Note the crew-compartment at the rear of the driver's cab. Foam and CO_2 are the principal "armament" of this vehicle.

For local use in and about airfield buildings—G.F.A. C.B. hand-carriage.

(Above) Primarily intended as precautionary equipment against engine-starting fires, this Pyrene Vespa-powered vehicle carries two CO_2 cylinders.

(Right) Airfield fire tender by Douglas Equipment, Ltd., powered with a Commer 109 h.p. engine.

finely atomized droplets. G.F.A. give the following account of a demonstration of this vehicle, using the C.B. as a "knock-down" agent in conjunction with foam:—

"A twin-engined aircraft was flooded with 500 gallons of petrol in the fuselage, wing cavities and surrounding area. The 'crash' was then ignited and, after a lapse of 60 sec, the fire was attacked at a given signal. Complete extinction was obtained in 1¼ min, a time which included a run of some distance by the tender to the burning aircraft. Rescue was possible within 45 sec of the initial attack."

For protection of airfield buildings, etc., G.F.A. produce a 12-gallon C.B. container (shown opposite) mounted on a hand carriage, provided with 75ft of hose and applicator, and pressurized by means of a nitrogen cylinder.

G.F.A. C.B. equipment has been ordered for a number of airfields under colonial administration. The Australian Department of Civil Aviation has issued tenders for the supply of C.B. for airfield light rescue vehicles. The Air Ministry has already specified C.B. for use in conjunction with foam, on new types of R.A.F. crash tenders.

High speed—over 55 m.p.h. is claimed—is a performance feature of one of the range of fire tenders by **Douglas Equipment, Ltd.,** Cheltenham. Utilizing a Commer 109 b.h.p. petrol engine, with specially waterproofed ignition and carburation systems, it has a four-wheel, four-wheel-drive chassis of 10ft 6in wheelbase, carrying water and foam compound tanks and a Coventry Climax Type FF 500 pump. Driven by a power take-off, the pump supplies two 2½in water-delivery lines. Two mechanical foam generators are permanently connected to the pump and the foam tank, and foam can be delivered at 1,250 gal/min with a 60ft (minimum) jet. The tank capacity, it is stated, permits a continuous run of approximately 30 min. The vehicle can also be employed as a standard fire appliance operating from hydrant supplies.

This is one of a wide range of Douglas petrol- and diesel-engined fire tenders, of from one to 25 tons' payload, and with various wheel and drive arrangements (viz., 4 × 2, 4 × 4, 6 × 2, and 6 × 6). Among these vehicles is a type which, now being produced for the M.T.C.A., has six wheels, with drive to all six from a Rolls-Royce B.81 petrol engine. A four-speed primary gearbox and Douglas three-speed auxiliary gearbox give 12 forward speeds and three reverse.

The chassis carries an equipment-load of up to 16 tons, including 50 gallons of foam compound and 1,500 gallons of water in an installation produced by the Sun Engineering Co. The vehicle is capable of 45 m.p.h. at full load.

The latest airfield crash tenders introduced by the **Pyrene Co., Ltd.,** of Brentford, Middlesex, include the Mk 5A, designed to R.A.F. requirements, and a civil version known as the Mk 5AC. Both vehicles are fast and manœuvrable over rough ground, and in each case use is made of a new method of generation which, it is stated, provides a large quantity of dense, tenacious foam at an unusually high rate of discharge—5,000 gal/min for 90 sec at the maximum rate.

Provision of a 2,500 gal/min foam monitor, which can be directed from inside the driving compartment, allows a crash fire to be attacked the instant the tender reaches the scene—sometimes, in fact, before it has come to a standstill, for the foam jet has a throw of up to 114ft.

There are also four 60ft lines of foam delivery hose, two on each side of the vehicle. In normal practice, the two lines nearest to the outbreak are brought into action after the monitor has made the initial attack at close quarters and from different angles. It is possible to bring one line into operation while the monitor is still in action, the two sources of foam combining to give over 4,000 gal/min. Both monitor and hand-line nozzles have attachments which allow either a jet or a 30 deg spray.

This type of tender is built on a Thornycroft "Nubian" chassis powered by a Rolls-Royce B.80 engine of 160 b.h.p. Ancillary fire-fighting equipment includes four Pyrene 25lb dry chemical (CO_2 pressurized) extinguishers.

A dry chemical installation forms the equipment of another Pyrene airfield vehicle, the light-duty crash tender, which, utilizing a Land Rover chassis, can travel over extremely rough ground and take routes denied to a larger vehicle. The dry chemical powder is carried in a container, of 150 lb or 200 lb capacity, which is pressurized by a CO_2 cylinder, and discharge is through two 50ft lengths of 1in i.d. high-pressure hose. The powder is automatically "fluffed" to ensure a smooth flow.

For situations where such a vehicle is required, Pyrene make an all-CO_2 tender, carrying a battery of 50 lb or 80 lb light-weight cylinders discharging into two 100ft hose reels. A gas output of 600 lb/min is obtainable.

Numerous other items included in the Pyrene aeronautical range may be briefly summed up as follows:—

Water tenders (1,000 gallons), capable of rapid movement over rough ground, and intended to refill foam tenders in action. The *F.T.4 trailer,* for towing behind any suitable vehicle, carries 200 gallons of water and 16 gallons of foam compound, and, on the power of its Coventry Climax pump, can deliver a total of 2,000 gal/min of foam through two lines. *Mobile CO_2 Units,* primarily intended for dealing with engine-starting fires—two 12 lb cylinders, with hose and self-extending applicator, are carried on a Vespa's sidecar (see illustration). *CDT 212A trolley,* carrying two 12 lb cylinders, applicator, etc.—standard R.A.F. and M.T.C.A. equipment for engine-fire precautions.

In *Flight* of February 26th, 1954, we described in some detail a new crash-fire tender by **Airfoam Fire Protection, Ltd.,** of London, S.W.1. On a Thornycroft Nubian 4 × 4 chassis is mounted foam, water and CO_2 equipment, this including a 6in multiple-jet monitor.

The fire-pump division of **Coventry Climax Engines, Ltd.,** of Coventry—who since 1937 have supplied over 30,000 appliances to users throughout the world—make a variety of compact yet powerful trailer and portable units. They also supply pumps alone, and these meet the requirements of a number of manufacturers of various types of self-propelled fire tenders.

Newest of the range of pump units is the Type FWP, a portable installation capable of pumping water at 360 gal/min at 60 lb/sq in or 230 gal/min at 120 lb/sq in. A Coventry Climax four-cylinder o.h.c. engine provides the power. The FWP is supplied by the manufacturers in a variety of forms, and the pump assembly alone is employed in the Firefly Austin Champ, a powerful little four-wheeled-drive fire tender supplied by **Fire Armour, Ltd.,** of London, W.1. Extra equipment includes dry powder, C.B.M. and foam.

The firm of **Antifyre, Ltd.,** of London, W.3, whose "Aero Pistole" extinguishers (described in *Flight* of February 19th, 1954) are widely used in aircraft, also make a standard, slightly

Vosper 46ft rescue tender, equipped with fire pumps and monitors.

Illustrating the method of using the Black and Decker rescue saw to cut an opening in a fuselage wall.

AIRPORT SAFETY . . .

larger device of the same design, suitable for use in hangars and other buildings. Shaped like a pistol, and actuated by a trigger, it employs a small propellant charge to eject a cloud of finely divided chemical powder which snuffs out flame with a combined de-oxygenating and beating effect. Also made by this company are the "Foam King" extinguisher and the Alert "T" soda/acid extinguisher, both of which have bodies of specially thick steel for durability.

Nu-Swift, Ltd., of Elland, Yorkshire, employ chlorobromomethane in their new Chloro-Flash extinguishers, in which the agent is stored at 250 lb/sq in in admixture with CO_2.

Specialists in CO_2 equipment of many kinds, the **Walter Kidde Co., Ltd.**, of Northolt, produce fire-fighting equipment employing this medium.

Among ancillary equipment used in airfield rescue work is a device which, though introduced less than three months ago, has attracted a great deal of attention and has already been ordered for the equipment of M.T.C.A. airfields. Made by **Black and Decker, Ltd.**, of Harmondsworth, Middlesex, it is a portable power saw (see illustration above) designed to cut into the structure of a crashed aircraft. Taking its 110v electrical supply from a suitable generator-equipped vehicle, the saw can cut a complete 3ft-square section out of a fuselage in about 15 sec.

Another item of equipment consists of breathing apparatus for use in dense smoke or toxic fumes. Equipment of this kind is a speciality of **Siebe, Gorman and Co., Ltd.**, Surbiton, Surrey, who state that they have supplied large numbers of their Mk 11 compressed-air breathing apparatus for use on crash tenders. Self-contained, the equipment supplies air, on the "demand" system, for durations ranging from about 75 min (light-work breathing) to 25 min (hard work).

MARINE EQUIPMENT.—When attention is turned to the equipment of marine bases a different set of circumstances obtains; the purely rescue aspect is predominant, and fire-fighting takes a secondary place. The reasons, of course, are obvious: aircraft of any type, military or civil, are liable to "ditch" in the sea, and such ditchings are seldom accompanied by fire; and fires in marine aircraft are very rare, if only for the reason that, in this country at any rate, flying-boats are now rarities and floatplanes virtually non-existent.

As specialists in high-speed craft, **Vosper, Ltd.**, of Portsmouth, have developed rescue vessels to a high degree of efficiency. A new 68ft craft for the R.A.F. evolved in conjunction with the M.o.S., is designed to take, eventually, the marine version of the Rolls-Royce Griffon engine. In standard form it has a wooden hull, but an experimental craft is of mixed welded-aluminium and glass-fibre construction; on the power of two Marine Griffons it has recently exceeded 40 kt over the measured mile.

Vosper search-and-rescue vessels supplied for the R.A.F. during the past few years have, in general, been of the 68ft type, capable of about 26 kt with three Napier Lion engines.

Some time ago Vospers built two special-purpose prototype fire-floats, a 55ft craft of steel and a 60-footer of aluminium alloy. Both are exceptionally manœuvrable and have low superstructures, to permit them to pass under the wings of marine aircraft. In each case there are two pumps, each capable of delivering 500 gal/min against a head of 300ft.

The main fire-fighting "armament" consists of two monitors each capable of projecting foam at 1,800 gal/min or water at 350 gal/min, and two smaller dual-purpose monitors are also fitted. In addition, pourers are installed 1ft above the waterline for spreading a foam blanket on the surface.

The larger of the two craft has Voith-Schneider propellers designed to act also as rudders and to give directional counterthrust to the reaction of the monitor jets. The smaller vessel has Rotol v.p. propellers.

Yet another type of Vosper craft is designed to combine the duties of rescue and fire-fighting. With a top speed of 28.8 kt and endurance of 5 hr at that speed or 11 hr at cruising speed, it is equipped to pump 500-600 gallons of water or 2,250-2,260 gallons of foam per minute. The fire pump can also be used as a salvage pump. Rescue equipment includes a device for lifting completely helpless casualties from the water. The 46ft hull is of fireproofed wood. An interesting point concerning the 375 h.p. Rover Meteorite engine is that a cartridge starter is fitted, to assist in getting under weigh in the shortest possible time. This launch can also act as an efficient tug and one was, in fact, so used for handling the Princess flying-boat.

The firm of **J. Samuel White and Co., Ltd.**, have designed and built, to M.o.S. order, a number of 40ft seaplane tenders capable of 24 kt and of carrying fire-fighting equipment.

A most unconventional but highly efficient type of fire-float has recently been designed and constructed by the **R.F.D. Co., Ltd.**, of Godalming, Surrey. Known as the "Bikini" fire-fighting raft, it consists basically of four independent fabric buoyancy tubes, inflated by two CO_2 cylinders and so arranged as to provide a mounting platform for three Type FWP pumps, capable of delivering water at a combined rate of 1,000 gal/min. An ingenious feature is that the craft is both propelled and steered by a water jet from one of the pumps.

THE INDUSTRY IN BRIEF

Blackburn and General Aircraft, Ltd., are to hold an extraordinary general meeting on March 24th, at which a proposal will be made to increase the company's capital from £1¼m to £2m by the creation of 1,500,000 Ordinary shares of 10s. each.

The General Electric Co., Ltd., announces that Mr. R. N. Millar, lately chief mechanical engineer to British General Electric Co. (Pty.), Ltd., Australia, has been appointed to take charge of its newly formed industrial atomic energy section. The new organization is located at the company's Erith works, under the direction of Mr. Arnold Lindley.

As briefly mentioned last week in our notes on Airwork Atlantic's inaugural transatlantic freight service, one of the items carried in the DC-4 was the "world's fastest camera"—actually the sequential image converter (see p. 26, *Flight*, January 7th) designed and built by Winston Electronics, Ltd., of Hampton Hill, Middlesex. The instrument, which is to be used in American weapons research, was packed in three special shockproof cases by Specialist Packers, Ltd., of London. Winston Electronics felt that air carriage was the safest and quickest way.

It is announced that Mr. C. D. Skinner, who until recently was manager of the aircraft division at Western Manufacturing (Reading), Ltd., has now joined Teddington Aircraft Controls, Ltd., in an executive capacity.

The Vickers-Armstrongs (Aircraft) Local Scholarship for 1955 has been awarded to 18-year-old-student-apprentice John Geoffrey Hicks, as the outstanding apprentice of the year. Mr. George Edwards (managing director) recently presented him with a certificate of the award of the scholarship, the purpose of which is to enable the winner to study for a degree in aeronautical engineering.

Mr. G. M. Hobday, appointed aircraft service manager to the English Electric aircraft division. He joined the company from Westlands in 1945, and for three years was English Electric advisory engineer at the Glenn Martin Baltimore works, on Canberra production.

Mr. D. W. Bottle, B.Sc., A.C.G.I., A.M.I.Mech.E., A.F.R.Ae.S., who, as we recorded last week, has been appointed to the post of chief aerodynamicist at Short Brothers and Harland, Ltd., Belfast. He was formerly at the R.A.E., Farnborough, and A. and A.E.E., Boscombe Down.

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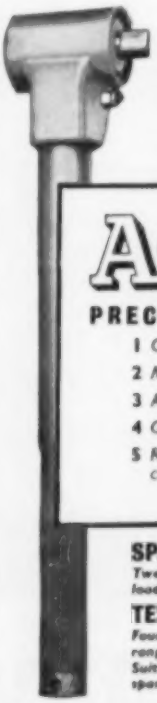

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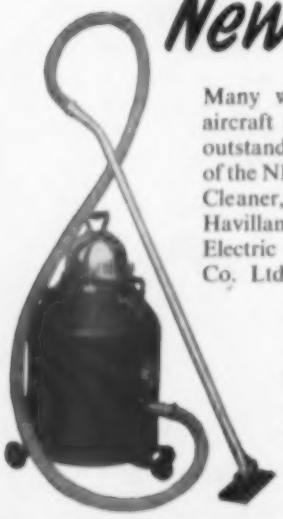

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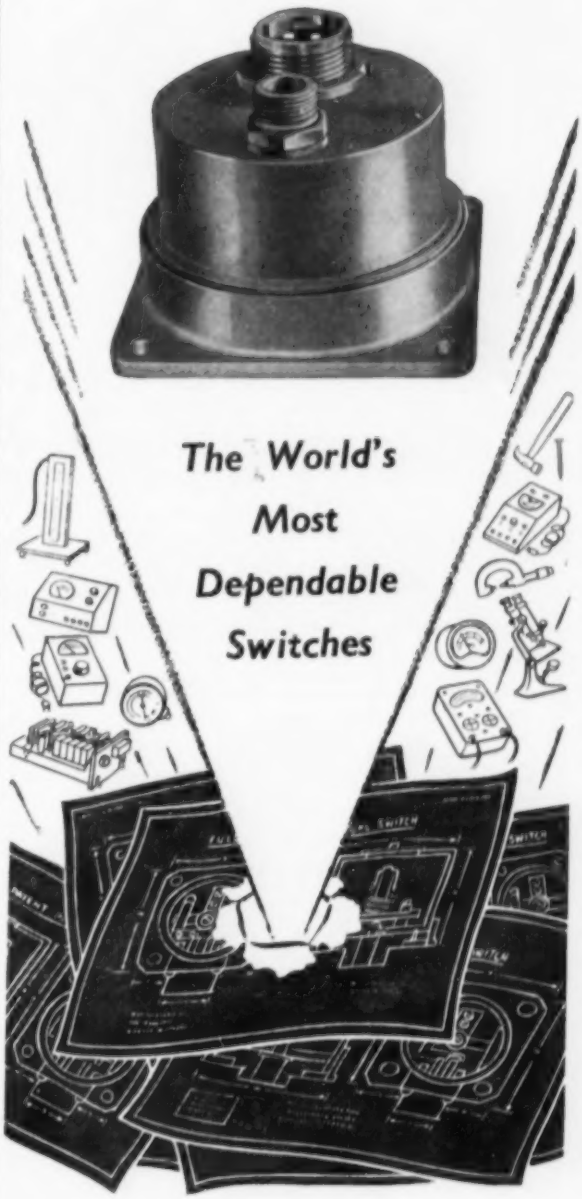

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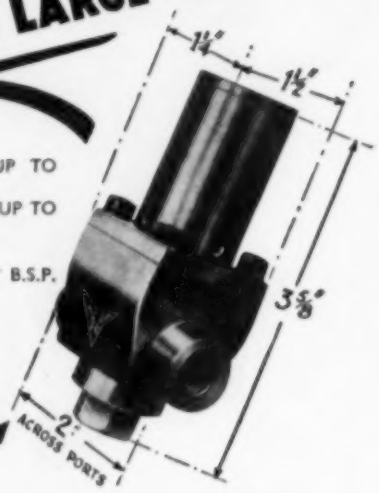

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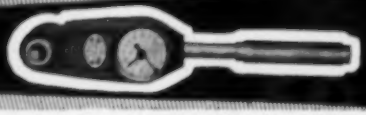

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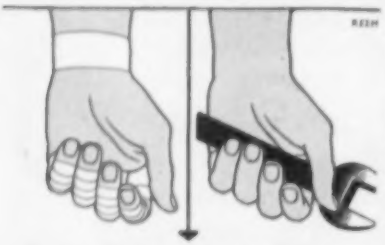

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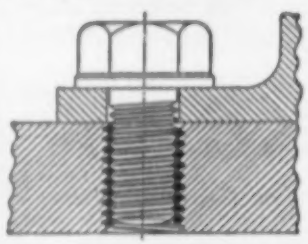

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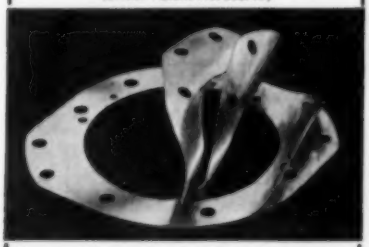

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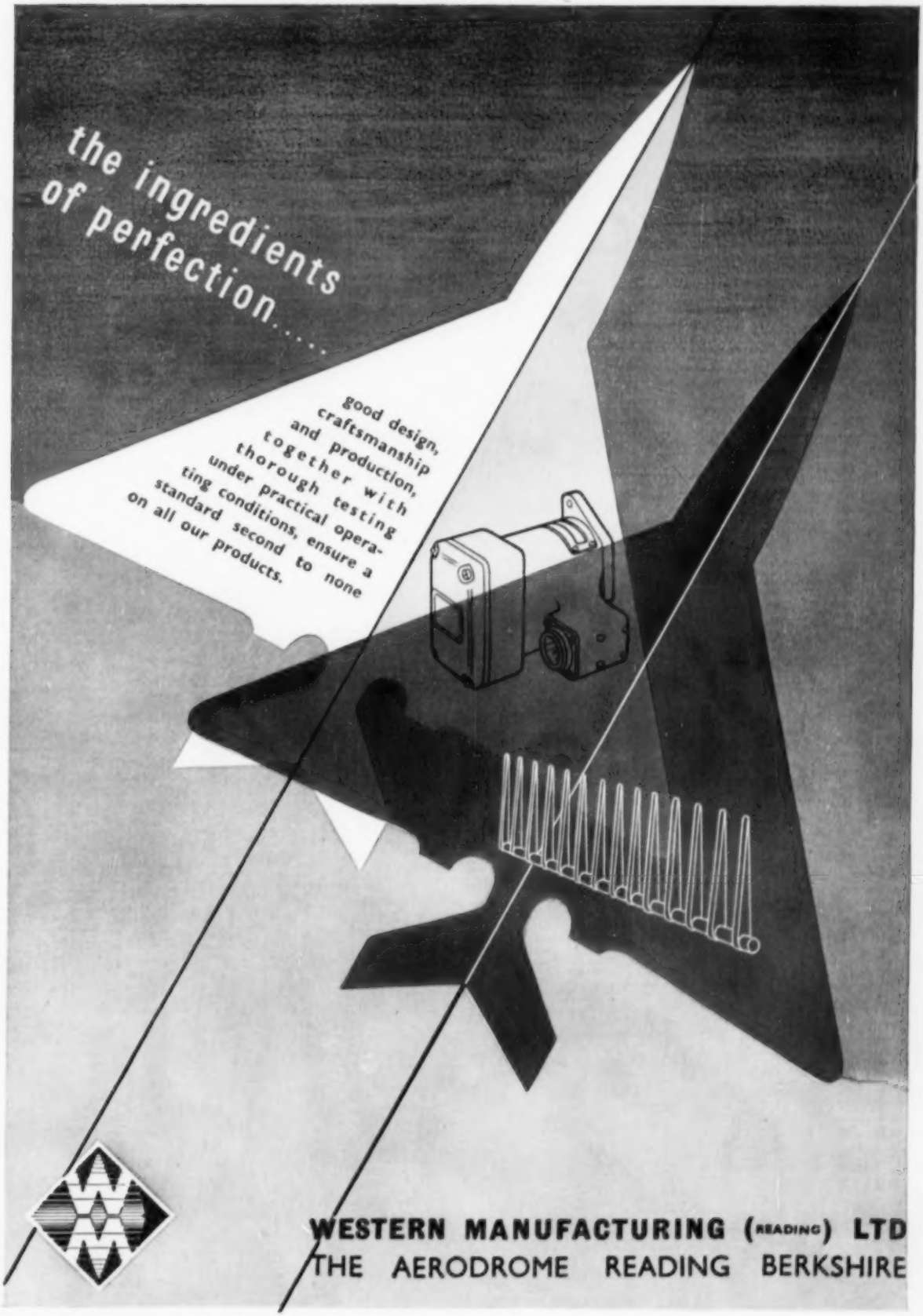
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